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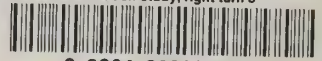
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MONTANA CONSERVATION STUDY: RIGHT TURN ON RED

Prepared for
THE MONTANA ENERGY OFFICE

by

Telesis, Inc.

Principal Consultant: Dr. John O. Picton
7675 S. W. 136th Avenue
Beaverton, Oregon 97005
(503) 643-5837

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TABLE OF CONTENTS

INTRODUCTION	1
PURPOSE OF THE STUDY	3
BACKGROUND INFORMATION AND RELATED STUDY	4
Background Information	4
The National Study	8
STUDY DESIGN	28
Right Turn On Red Traffic Observation	28
Public Opinion Poll	31
Traffic Density	31
FINDINGS	32
Right Turn On Red Traffic Observation	34
Public Opinion Poll	43
ENERGY SAVINGS FROM RTOR UTILIZATION	61
CONCLUSIONS AND RECOMMENDATIONS	62
Conclusions	62
Recommendations	63
APPENDIX A: Maps of Field Test Cities Showing Intersections Observed	
APPENDIX B: Traffic Observation Data Collection Instruments	
APPENDIX C: Average Daily Traffic and Traffic Densities at the Locations Observed	
APPENDIX D: Public Opinion Poll Questionnaire	
APPENDIX E: Number of Respondents -- Public Opinion Poll RTOR Questions	

MONTANA ENERGY CONSERVATION STUDY: RIGHT TURN ON RED

INTRODUCTION

The supply of energy available in usable forms to the American public has become increasingly scarce and is affecting all parts of the United States. The availability of petroleum-based energy products has shifted dramatically in recent years and months, due not only to basic questions of supply and demand, but also to shifting local politics in oil-producing nations and the international changes that have occurred. Montana, like other states of the United States, is facing disruptive modifications in the energy supply and must face very critical questions concerning the future supply.

Although Montana has vast quantities of coal, the technology and plants are not in place to enable a shift to these local resources for all segments of Montana's energy economy. Montana, like the rest of

the nation, depends heavily upon the ready availability of petroleum energy resources for its economic and social functioning. Since relatively unlimited fossil fuel energy is no longer available, and all indications are that the situation will continue to deteriorate before it gets better, it behooves the people of Montana to conserve and use wisely the energy they do have available. For these reasons, and others, the State of Montana, under the strong leadership of the Governor and with broad support of the Montana Legislature, has implemented a plan of energy conservation and, in 1977, funded the Montana Energy Office in the Office of the Lieutenant Governor. The Montana Energy Office has primary responsibility for advising the Governor on all matters involving energy and energy related resources, and for developing a comprehensive energy policy for the State.

The comprehensive energy policy for the State included the plan for energy conservation. The plan focuses on specific methods of achieving immediate reductions of energy use by the people of Montana as a partial answer to the increasing problems caused by decreasing supplies. The plan also recognizes the importance of developing an energy conservation ethic for all Montanans which will result in their modifying their actions, where appropriate, to conserve and extend their use of energy supplies.

One of the major users of Montana's energy supplies is the Montana transportation sector. In 1974, Montana's transportation sector directly used 31% of the total energy consumed in the State. Gasoline accounted for 73% of the energy used in the transportation sector, with

highway diesel fuel accounting for another 9%. The remaining 18% was used by railroads. Thus, 81% of the State's transportation sector energy consumption was used on the roadways of the State. This means that one-fourth of Montana's total energy consumption is in the form of gasoline and diesel fuel which is consumed in transporting people and goods throughout the State.

Because the energy used by Montanans in transportation is so significant, it becomes important to seek ways to use the available energy more efficiently and to eliminate as much waste as possible. One of the ways this can be done is to devise safe methods for enabling vehicles to move through traffic as expeditiously as possible. One way to reduce the amount of wasted fuel is to enable drivers to reduce the time they are stopped in traffic to a minimum without endangering the lives and property or infringing upon the rights of others. Such movement facilitation can be aided by a "right turn on red" law which permits a driver to make a right turn on a red traffic signal after stopping and yielding the right-of-way to other vehicles and to pedestrians. Such movement can serve to reduce the idling time for automobiles and thereby conserve fuel. Because of the potential savings, Montana has included Right Turn On Red (RTOR) as one of their program measures in their 1977-78 Energy Conservation Plan.

PURPOSE OF THE STUDY

The purpose of this study was to assess the use or non-use of

Montana's "right turn on red" law; to make recommendations designed to increase the proper use of the right turn on red movement for the lowering of throughput times to conserve energy; and to perform computations as to the attainable decreases in the consumption of petroleum products as a result of this traffic movement.

BACKGROUND INFORMATION AND RELATED STUDY

In order to determine the use or non-use of Montana's "right turn on red" law and to make recommendations and calculations concerning energy conservation, it was necessary: (1) to define Montana's "right turn on red" law and to examine related background information; and (2) to examine the results of a national study which included some of these same elements. The background information on the Montana law will be presented next, followed by a summary of the national study.

Background Information

The March, 1977, Montana Energy Conservation Plan, which was revised in June, 1977, and January, 1978, had as one of its program measures: Right Turn On Red. Montana's "right turn on red" traffic law was enacted on July 1, 1975 (RCM 32-2137) and reads as follows:

Vehicular traffic facing the signal shall stop before entering the crosswalk on the near side of the intersection or, if none, then before entering the intersection and shall remain standing until green or "Go" is shown alone or until a right turn can safely be made and in making such turn vehicular traffic must yield the right-of-way to pedestrians lawfully within the crosswalk and to other traffic lawfully using the

intersection. If a traffic sign legend indicating that no right turn on red may be made after a stop is posted at said intersection, such movement cannot be made until green or "Go" is shown alone.

This law meets the definition of "right turn on red" as defined in the 1976 Right-Turn-On-Red national study which states:

By definition, RTOR means permitting a right turn on a circular red traffic signal after stopping and yielding the right-of-way to vehicles and pedestrians....RTOR is not to be confused with the practice of allowing right turns at a signalized intersection via channelization or allowing right turns on a flashing or steady green or yellow arrow.

The "right turn on red" traffic law originated in 1937 in California and was utilized in many Western states, but is now in general use throughout the nation.

The importance of a "right turn on red" law in terms of energy conservation is illustrated on the logic chart for the transportation sector included in "The Montana Energy Conservation Plan," revised 1978, which is replicated on pages 6 and 7.

An examination of the logic chart illustrates that by encouraging right turn on red, one can optimize traffic flow which, in turn, will improve miles per gallon of fuel consumption, which will improve efficiency of roadway transportation, and thereby reduce energy consumption in the transportation sector.

Since, as was indicated in the introduction, one-fourth of Montana's total energy consumption is consumed in the form of gasoline and highway diesel fuel and the fact that such products are in short supply and most probably will continue to be limited in availability,

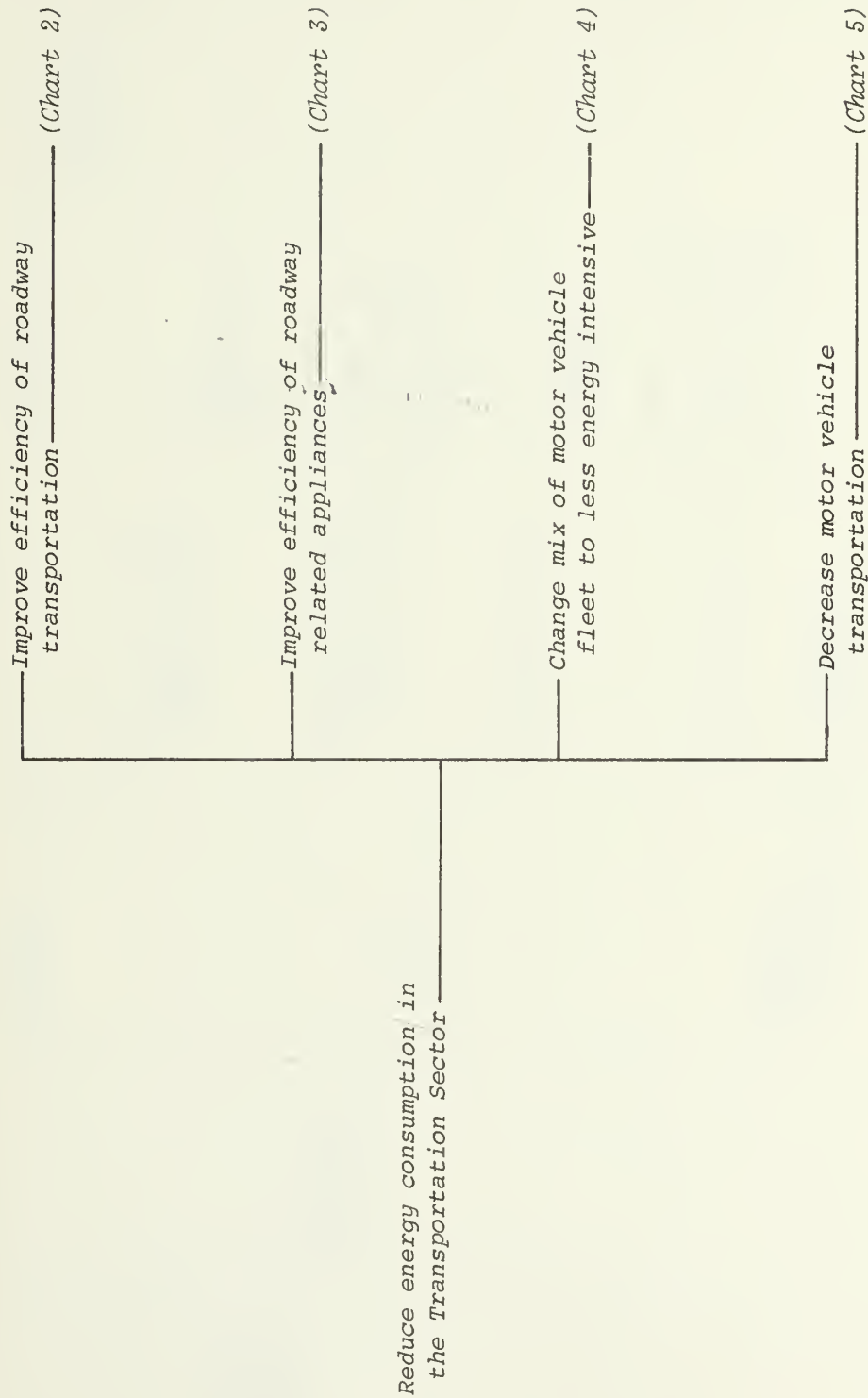


Figure IV-5. TRANSPORTATION SECTOR
Chart 1

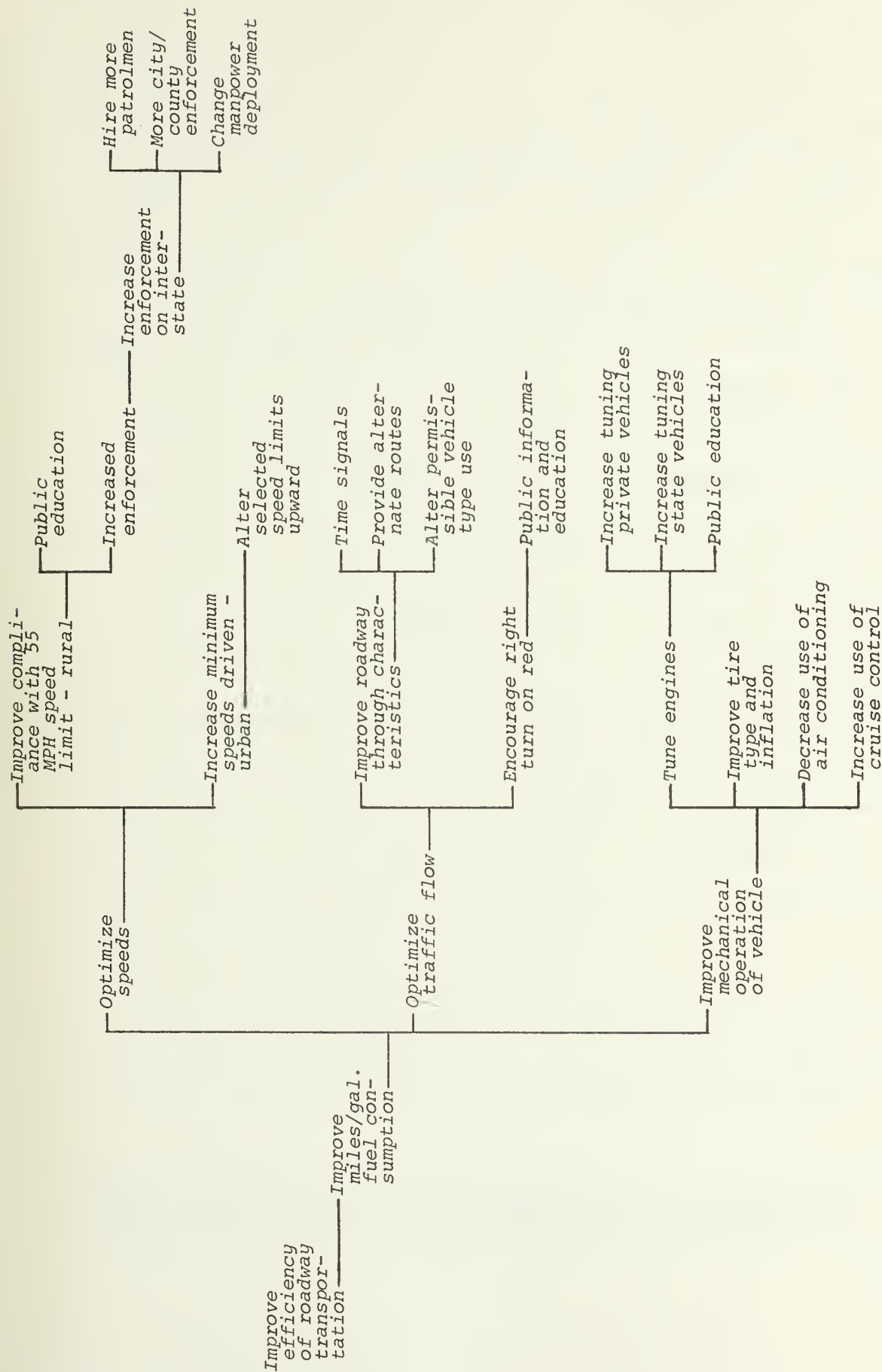


Figure IV-6. TRANSPORTATION SECTOR
Chart 2

the effective use of the "right turn on red" law can contribute to the conservation and improved utilization of Montana's energy sources.

The National Study¹

A right turn on red research project was undertaken by the Federal Highway Administration at the request of the National Advisory Committee on Uniform Traffic Control Devices and was completed in 1976. The objectives of the study were to determine whether or not right turns on a red signal should be permitted after stopping and yielding the right-of-way to vehicles and pedestrians lawfully in the intersection, and if such turns were permitted, to determine which locations and how RTOR should be implemented. Among the findings of this study, RTOR was found to reduce delay, increase intersection throughput, and reduce fuel consumption and auto emissions. Because of these findings, the research project was considered to be significant to energy conservation in Montana in terms of right turn on red and, therefore, has been made a part of this study. A summary of the sections of this national study which appear pertinent to Montana energy conservation through the "right turn on red" law follows.

The stated objectives for the Right-Turn-On-Red study for the Federal Highway Administration were: (1) "To determine whether permitting RTOR is desirable;" (2) "To prepare guidelines for determining

¹Report No. FHWA-RD-76-89, Right-Turn-On-Red, Vol. 1, Final Technical Report, May 1976, Final Report, Federal Highway Administration, Offices of Research & Development, Washington, D.C. 20590

inclusion or exclusion of this movement;" and (3) "To prepare guidelines for applying the necessary controls." In order to attain these stated objectives, the study was conducted in two phases. The first one, utilizing a questionnaire survey of all the states and the literature review of previous studies, examined the following factors:

- (1) Physical intersection characteristics
- (2) Operational characteristics (vehicle/pedestrian)
- (3) Accident experience
- (4) Legal regulations
- (5) Public acceptance (driver/pedestrians)
- (6) Law enforcement
- (7) Signing

The second phase of the study was designed to provide actual data concerning right turn on red, which in turn provided the following measures of effectiveness which were utilized in making recommendations for national policy and implementation guidelines concerning RTOR:

- (1) Vehicle delay, fuel and emission savings
- (2) Intersection throughput improvements
- (3) Accident experience
- (4) Driver and pedestrian attitudes
- (5) Legal and law enforcement problems

The study of vehicle delay, fuel and emission savings, and intersection throughput involved the collection of field data utilizing time-lapse photography data collection techniques and extensive computer simulation analyses to quantify the effects of RTOR on vehicle delay,

intersection throughput, fuel savings, and vehicle emissions.

The study of the driver and pedestrian attitudes measure of effectiveness involved the use of driver and pedestrian surveys to provide information on public knowledge, attitudes, and preferences for right turn on red. The driver survey was administered in six states using a questionnaire format, while the pedestrian survey was conducted in four cities using on-street interviews.

The final phases of the national study included the development of recommendations for a national policy on right turn on red for the development of guidelines for the implementation of the selected right turn on red rule.

The study reported that there are basically four rules existing which cover right turn on red, namely:

- (1) RTOR totally prohibited;
- (2) RTOR is generally prohibited except where signed to allow it at selected locations;
- (3) RTOR is generally permitted except where signed to prohibit it at selected locations;
- (4) RTOR is totally permitted.

The third rule, which is usually identified as the "generally permissive rule," was initially developed in the Western states and is the one, combined with a stop and yield requirement, that Montana follows.

The field studies of right turn on red consisted of eight intersections in each of the states of Colorado, Indiana, and Virginia. The selection of these states and the timing of the data collection enabled the researchers to gain information both before and after the implementation

of an RTOR rule. The data on RTOR utilization were from a total of 40 intersection approaches for one hour of peak traffic and one hour of off-peak traffic at each approach. The table from the national Right-Turn-On-Red study, which is reproduced in Figure 1 on page 12, shows that the RTOR utilization at the field study sites range from a low of approximately 11.8% of all right turns in central business districts (CBD's) through a high of 28.3% in rural areas, with an over-all utilization rate of 19.8%. It should be noted that statistics in Figure 1 are for single-hour samples representing an average of peak and off-peak traffic conditions.

The national study included data concerning RTOR utilization by approach type for peak and off-peak hours. An examination of the data, reproduced in Figure 2, page 13, would seem to indicate that the existence of a turn pocket greatly facilitates the RTOR maneuver, with a resulting utilization rate approximately double that of an approach without a pocket (28% to 13%).

The utilization of the RTOR law also appears to be influenced significantly by the level of pedestrian traffic. An examination of the RTOR utilization by pedestrian level table in Figure 3, page 14, reveals that RTOR utilization under conditions of very light pedestrian traffic is double that for medium or heavy pedestrian traffic and nearly double the "very light" utilization rate. During off-peak periods, the RTOR utilization for very light pedestrian traffic was 27.5%, but dropped to 2.5% and 0.9% for medium and heavy pedestrian traffic, respectively.

Table 2. RTOR utilization by area type and RTOR rule.

Land Use Area Type	RTOR Rule	No. of Approaches in Aggregation	Average Approach					Average RTOR ¹ Utilization (No. RTOR/No. Right Turn) x 100 Percent
			Ratio of Red Phase to Cycle Length	Hourly Ped. Volume on Near Crosswalk	Hourly Cross-Street Through Volume From Left	Total No. of Right-Turn Vehicles	No. of RTOR Vehicles	
CBD	Sign	2	.50	19	428	170	10	6.0
	General	5	.54	238	319	83	14	16.5
	Both	7	.53	176	350	108	13	11.8
Non-CBD Urban	Sign	12	.53	5	379	68	13	18.4
	General	11	.50	21	549	88	15	16.8
	Both	23	.52	13	460	78	14	17.5
Rural	Sign	2	.50	2	348	63	24	37.8
	General	8	.47	0	315	132	36	27.2
	Both	10	.48	1	321	118	33	28.3
All	Sign	16	.52	6	381	81	14	17.0
	General	24	.50	59	423	102	22	21.2
	Both	40	.51	38	406	93	18	19.8

¹Computed from aggregate totals, not averages at left

Table 6. RTOR utilization by approach type and hour of traffic.

Hour of Traffic	Data Aggregated By Approach Type	Number of Approaches	Average Approach					RIGHT-TURN-ON-RED Utilization 1/ (Percent)
			Ratio of Red Phase to Cycle Length	Hourly Pedestrian Volume on Near Crosswalk	Hourly Cross-Street Through Volume From Left	Number of Right-Turn Vehicles	Number of RTOR Vehicles	
Peak	W/O Turn Pocket	24	.53	52	556	106	12	11.7%
	W/Turn Pocket	16	.49	44	351	126	34	26.8%
Off-Peak	W/O Turn Pocket	24	.53	41	401	70	11	15.7%
	W/Turn Pocket	16	.48	7	245	77	23	30.5%
Average	W/O Turn Pocket	24	.53	46	479	88	12	13.3%
	W/Turn Pocket	16	.48	26	298	101	29	28.2%

1/ Computed From Aggregate Totals, Not Averages at Left

FIGURE 2. Reproduced from Right-Turn-On-Red, page 28.

Table 7. RTOR utilization by pedestrian level.

Pedestrian Level (Peds/Hour)	Hour of Traffic	No. of Approaches	Average Approach			RTOR Utilization ¹ (No. RTOR/No. Right Turn) x 100 Percent
			Ratio of Red Phase to Cycle Length	Hourly Cross-Street Through Volume From Left	Hourly No. of Right- Turn Vehicles	
0-10 "Very Light"	Peak	24	.50	404	124	21.5
	Off-Peak	26	.50	293	75	27.5
	Average	25	.50	346	98	23.9
10-50 "Light"	Peak	9	.53	574	91	12.4
	Off-Peak	12	.55	424	60	13.7
	Average	10½	.54	488	74	13.0
50-200 "Medium"	Peak	4	.50	706	103	11.7
	Off-Peak	1	.40	567	119	2.5
	Average	2½	.48	678	106	9.6
> 200 "Heavy"	Peak	3	.57	421	118	13.5
	Off-Peak	1	.50	278	109	0.9
	Average	2	.55	386	116	10.6

¹Computed from aggregate totals, not averages at left

FIGURE 3. Reproduced from Right-Turn-On-Red, page 29.

Data from the national study on right turn on red utilization during peak and off-peak hours of traffic are presented in Figure 4, below. It may be noted that RTOR appears to be utilized more often when the traffic is lighter.

Table 3. RTOR utilization by hour of traffic.

Hour of Traffic	Average Approach					
	Ratio of Red Phase to Cycle	Hourly Ped. Volume	Hourly Cross Traffic	No. of Right Turning Vehicles	No. of RTOR	RTOR ¹ Utilization (percent)
Peak	.51	49	474	114	21	18.4
Off-Peak	.51	27	339	72	16	22.0

¹Computed from aggregate totals, not averages at left

FIGURE 4. Reproduced from Right-Turn-On-Red, page 24.

An analysis of the data in the national study revealed that the right turn delay savings at the field study sites varied according to the type of area and ranged from a low of about 9% (1.3 seconds) in central business districts to 39% (7.7 seconds) in rural areas. The non-CBD urban area savings amounted to 4.2 seconds. Likewise, there was a variation in the right turn delay savings by the hour of traffic. The average right turn delay savings due to RTOR were about 26% (4.3 seconds) in the peak hour and 38% (5.2 seconds) in the off-peak hour.

The average RTOR utilization found in the field studies is as follows:

- * By land-use area type, RTOR usage was about 12% in the central business districts; 18% at non-CBD urban intersections; and 28% in rural areas.
- * Where the RTOR rule was generally permissive (as in Montana) the utilization rate was 21.2%.
- * The over-all utilization rate of 20% represents an average of about 18% in peak traffic periods and 22% in off-peak periods.
- * Intersection approaches with a right turn pocket had an average RTOR utilization of 28%, but those without a pocket had a rate of only 13%.
- * Average RTOR utilization ranges from 24% with very light pedestrian traffic to about 10% under medium or heavy conflicting pedestrian flows.

The field studies data indicated that the delay savings for an average right-turning vehicle had the following characteristics:

- * By land-use area type, the savings were about 9% (1.3 seconds) in central business districts; 31% (4.2 seconds) at non-CBD urban intersections; and 39% (7.7 seconds) in the rural areas.
- * The delay savings under the generally permissive rule for RTOR per right turning vehicle was 4.5 seconds.
- * The over-all right turn delay savings was 4.3 seconds in peak traffic periods and 5.2 seconds in off-peak periods.
- * Savings of right turn stop delay were nearly 41% on intersection approaches with right turn pockets and 27% on approaches without a pocket.
- * Delay savings generally were greater on a percentage basis than RTOR utilization and a given percentage increase in utilization could result in an even larger percentage increase in delay savings.

Another portion of the national right turn on red research study consisted of a comprehensive computer simulation of effects of right turn of red. An intersection throughput study was included in this simulation, with the following results concerning the effect of right turn on red on approach capacity:

- * RTOR significantly increases throughput.
- * The relative increase of throughput is generally higher where a right turn pocket exists.
- * Cross traffic volume does not strongly influence throughput where RTOR is permitted.
- * A two-lane approach with no pocket and with heavy pedestrian travel only marginally benefits from RTOR.

Under the computer simulation, three replications were calculated for the "before" (no RTOR) and "after" (with RTOR) cases. A summary of the results of this study are reproduced in Figures 5 and 6, pages 18 and 19. It may be noted from an examination of the data in the tables that RTOR resulted in improvement for all of the ten measures of effectiveness.

Conclusions drawn from this portion of Right-Turn-On-Red study include the following:

- * Implementation of right turn on red provides benefits for all the measures of effectiveness considered, including reduced delay, reduced gasoline consumption, and reduced vehicle emissions.
- * Intersection throughput is increased with RTOR.
- * The gain in throughput due to RTOR is not sensitive to cross-street volume if the volume is below saturation.

Table 22. Measures of effectiveness of RTOR for grid network
Operational MOE.

<u>Replications</u>	<u>Before (B)</u>	<u>After (A)</u>	<u>Percent Difference</u> ¹
<u>Total Delay (seconds)</u>			
1	191,850	185,256	
2	195,306	181,812	
3	<u>206,628</u>	<u>180,666</u>	
Average	197,928	182,578	7.8
<u>Total Stopped Delay (seconds)</u>			
1	142,161	135,607	
2	146,089	130,723	
3	<u>157,037</u>	<u>130,079</u>	
Average	148,429	132,136	11.0
<u>Average Delay/Vehicle (seconds)</u>			
1	55.6	53.7	
2	56.8	52.7	
3	<u>60.0</u>	<u>52.2</u>	
Average	57.5	52.9	8.0
<u>Average Speed (mph)</u>			
1	10.5	10.7	
2	10.3	10.8	
3	<u>10.0</u>	<u>10.9</u>	
Average	10.3	10.8	-4.8
<u>Vehicle Seconds</u>			
1	326,538	321,270	
2	329,634	317,586	
3	<u>341,700</u>	<u>315,870</u>	
Average	332,624	318,242	4.3
¹ Percent Difference: $\left(\frac{B-A}{B} \times 100 \right)$			

FIGURE 5. Reproduced from Right-Turn-On-Red, page 72.

Table 23. Measure of effectiveness of RTOR for grid network
Energy and emissions MOE (automobiles only).

<u>Replications</u>	<u>Before (B)</u>	<u>After (A)</u>	<u>Percent Difference</u> ¹
<u>Fuel Consumption in Gallons</u>			
1	109.9	108.5	
2	109.8	107.6	
3	<u>112.7</u>	<u>107.7</u>	
Average	110.8	107.9	2.6
<u>Miles/Gallons</u>			
1	8.2	8.3	
2	8.1	8.3	
3	<u>8.0</u>	<u>8.3</u>	
Average	8.1	8.3	-2.8
<u>HC Emissions (Gr/Mile)</u>			
1	5.1	5.0	
2	5.1	5.0	
3	<u>5.3</u>	<u>4.9</u>	
Average	5.2	5.0	-3.6
<u>CO Emissions (Gr/Mile)</u>			
1	92.4	90.5	
2	93.5	89.9	
3	<u>96.0</u>	<u>89.3</u>	
Average	94.0	89.9	4.3
<u>NO_x Emissions (Gr/Mile)</u>			
1	6.7	6.6	
2	6.7	6.6	
3	<u>6.8</u>	<u>6.6</u>	
Average	6.7	6.6	1.8
¹ Percent Difference: $\left(\frac{B-A}{B} \times 100 \right)$			

FIGURE 6. Reproduced from Right-Turn-On-Red, page 73.

- * The benefits due to RTOR generally increase with right turn percentage.
- * Provision of a right turn pocket without RTOR will, in general, result in increased capacity relative to implementation of RTOR with no pocket.
- * The quantitative benefits to be gained will vary with location and condition. For the network studied, in the absence of bus traffic, RTOR reduced total delay by 24.7% and fuel consumption by 7.5%. With bus traffic, RTOR reduced delay by 7.8% and fuel consumption by 2.6%.

Another segment of the national Right-Turn-On-Red study was a survey of driver and pedestrian attitudes toward right turn on red. The driver attitudes survey was conducted through a questionnaire distributed to motorists in six states while at license bureaus renewing their driver's licenses. In each state, approximately 300 survey forms were distributed equally to three branch offices in urban, suburban, and rural areas. No attempt was made in the national study to obtain equal samples of males and females or to distinguish by age. The survey included questions concerning the age, sex, and years of driving of the respondent and whether they were aware of their respective state's rule regarding RTOR. It also included such questions as:

"When you are allowed to turn right on a red light, how often do you do it?"

"Are you ever forced into making an RTOR by impatient drivers behind you?"

"Do you feel that RTOR is dangerous to you as a driver?"

"Do you feel that RTOR is dangerous to you as a pedestrian?"

Summaries of the responses to the driver survey are reproduced in Figures 7, 8, 9, and 10 on pages 21-24.

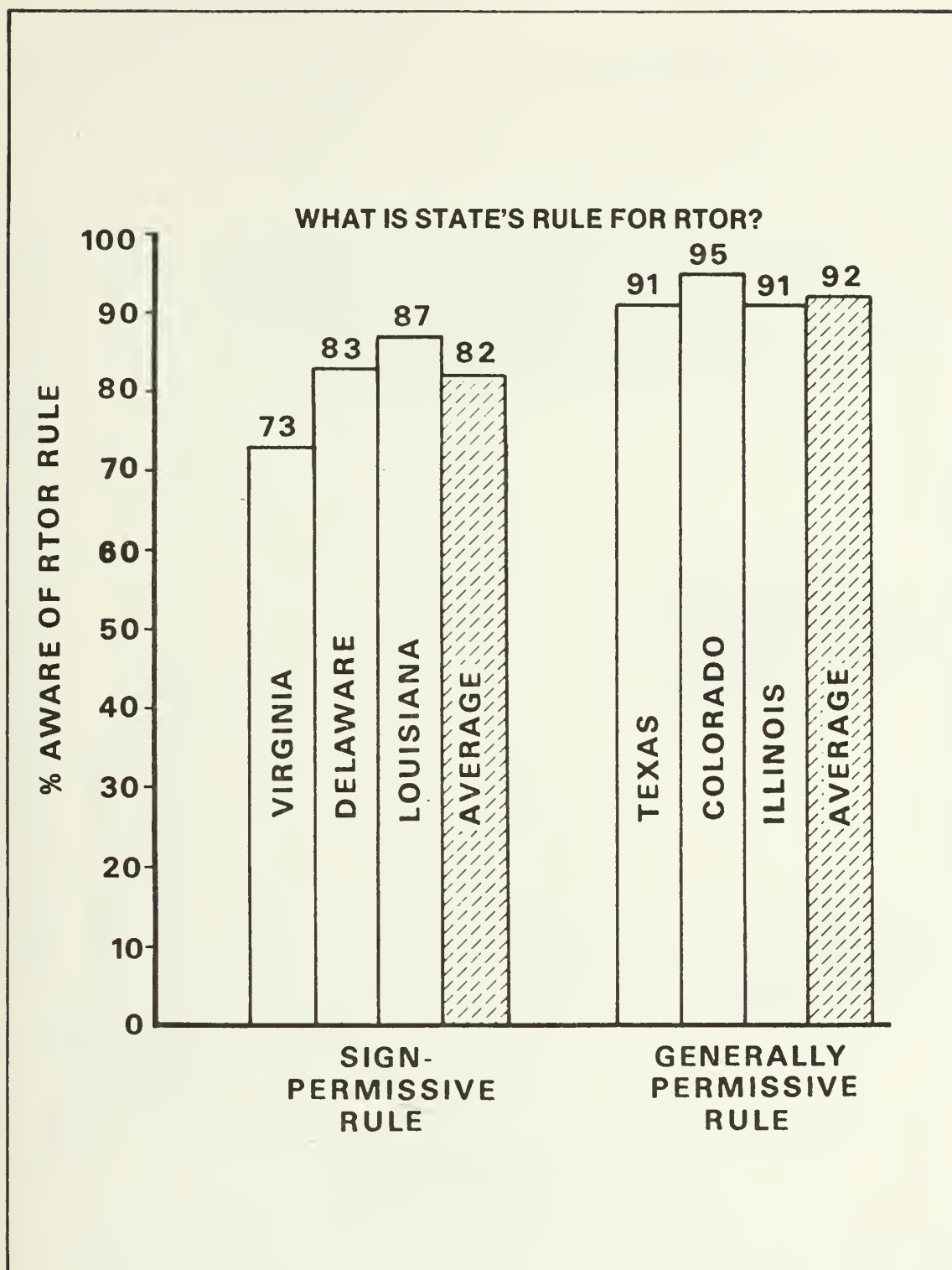


Figure 19. Driver survey results—question 4.

FIGURE 7. Reproduced from Right-Turn-On-Red, page 116.

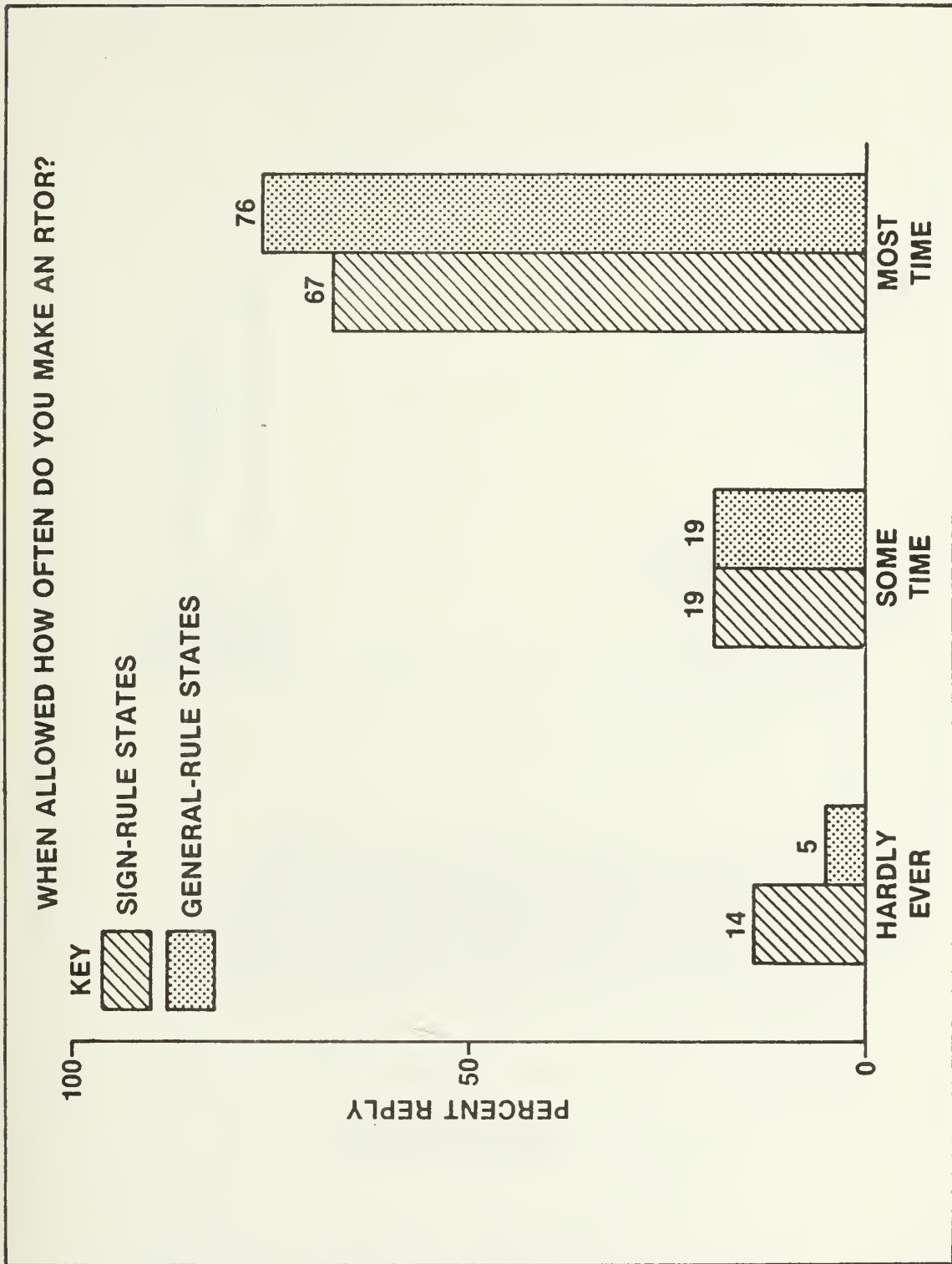


Figure 20. Driver survey results—question 5.

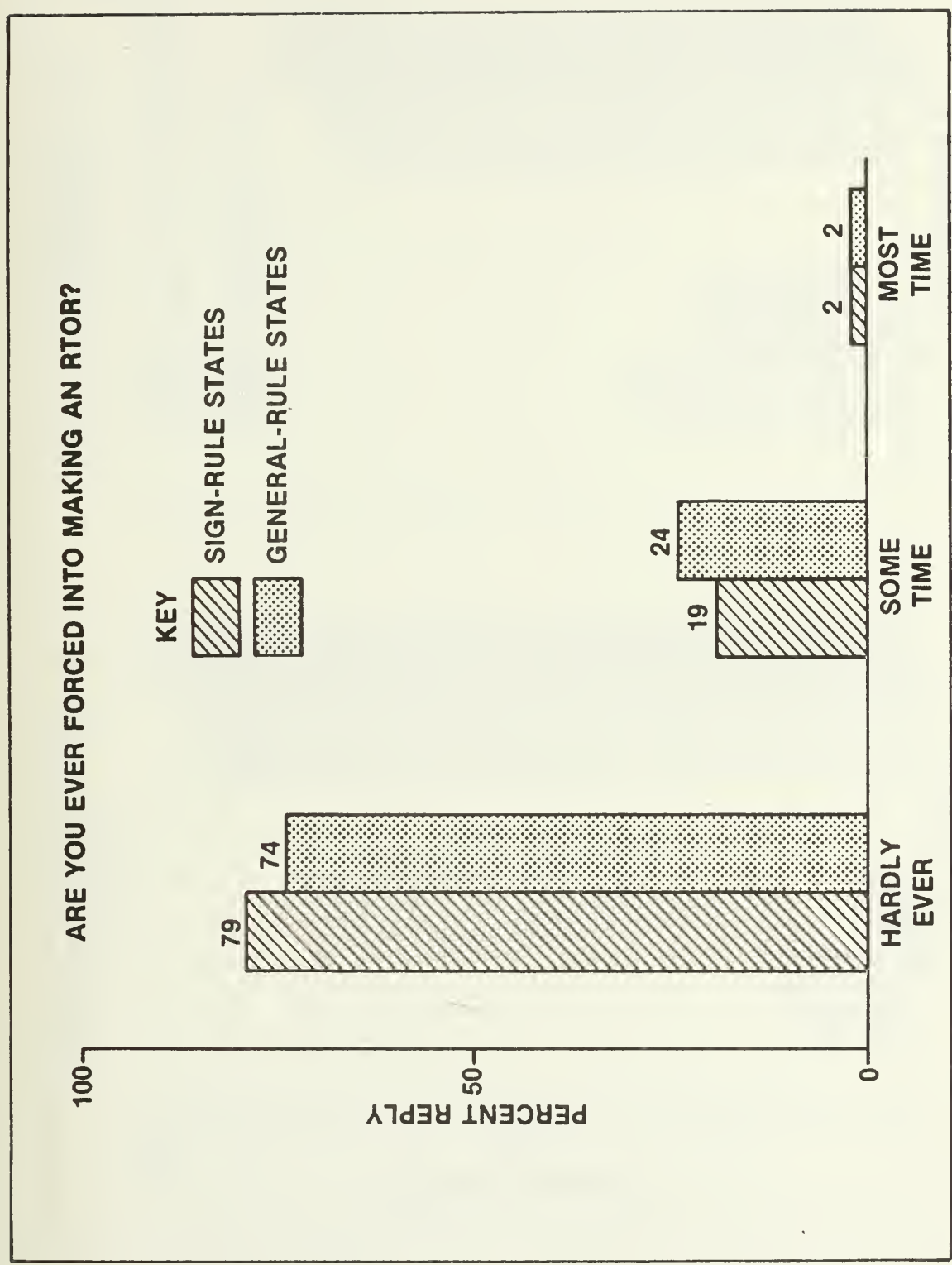


Figure 21. Driver survey results—question 6.

FIGURE 9. Reproduced from Right-Turn-On-Red, page 119.

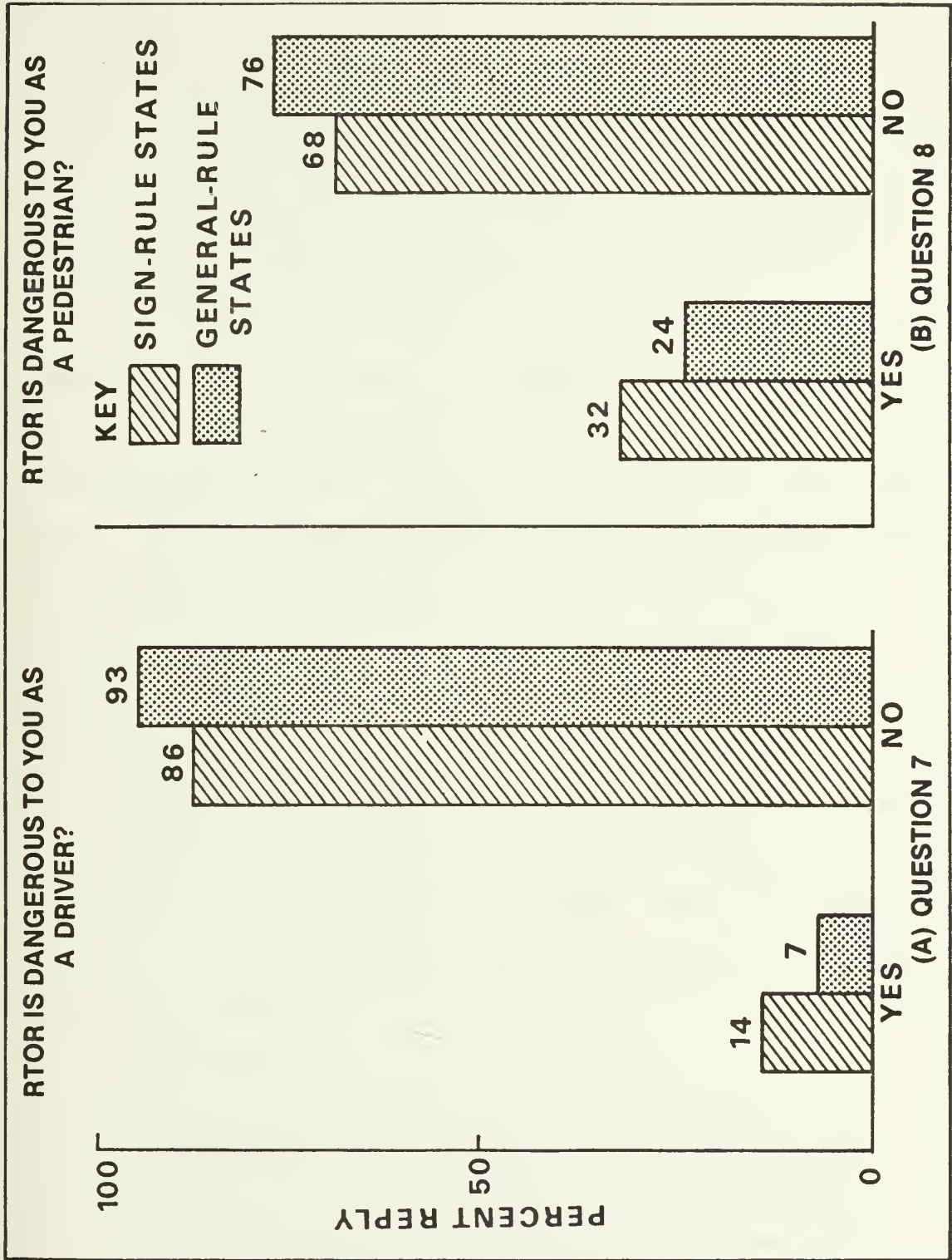


Figure 22. Driver survey results—questions 7 and 8.

An examination of these diagrams reveals that the number of drivers who were aware of their state's rule for right turn on red was higher in the states where it was a generally permissive rule than in those with a sign permissive rule. The average percent indicating awareness for the generally permissive category was 92 and for the sign permissive, 82. The question concerning the frequency of making right turns on red was answered with two-thirds to three-fourths stating "most of the time" and 19% "some of the time." Three-fourths of the respondents indicated that they hardly ever felt forced to make right turns on red. The drivers surveyed indicated, in approximately 90% of the cases, that they did not feel that RTOR is dangerous to them as a driver; however, when the question was asked concerning danger as a pedestrian, approximately one-fourth to one-third responded in the affirmative.

In addition to the findings already cited, two additional ones -- on delay savings and fuel savings -- were made on the basis of both the field study and the computer simulation study. Because they addressed questions of significance to this Montana study, they are presented here in their entirety.

Delay Savings

The results of both the field and computer simulation studies indicate that significant savings in delay accrue to motorists as a result of RTOR. For all the "approach studies" in the field, there was an average delay reduction of 7.5 seconds per stopped right-turn vehicle, which was a 25-percent reduction from the "No RTOR" condition. For all right-turning vehicles, the delay savings per vehicle was 4.6 seconds, which is a 30-percent reduction.

In the computer simulation analyses, total delay for all vehicles was found to decrease for all conditions studied, although the percent savings for one-lane approaches were statistically insignificant. For a network of 18 intersections in an urban area, total delay was reduced by 7.8 percent, and stopped delay was reduced by 11 percent. The results from both the field and computer delay studies indicate that RTOR provides delay savings for a vast majority of conditions, including during peak traffic periods.

Quantifying the economic benefits from the time savings would be most difficult and probably inappropriate. Presumably, the average delay savings could be applied to some average volume per day per intersection and extrapolated to all intersections. This aggregated delay savings could be multiplied by a dollar value of time to yield a total dollar savings. However, while this figure is likely to be in the millions of dollars for all motorists, for any individual motorist it would be a very small amount. The tangible savings that result from the delay reduction come from the reduction in fuel consumption discussed next.

Fuel Savings

Fuel savings accrue to motorists as a direct result of less idling time while waiting for the green signal. The general conclusions from the computer simulation analyses is that the RTOR feature reduces fuel utilization for most conditions. The most notable exception is the one-lane approach configuration because of less opportunity to make the RTOR maneuver.

From the simulation analysis, it was determined that for a network of signalized intersections in urban areas such as Washington, D.C., there could be an average fuel consumption savings of 2.6 percent for all vehicles through the system. In the isolated intersection analyses, it was shown that fuel savings expressed in gallons per vehicle-mile ranged from a low of 3.2 percent (one-lane approach with 10-percent right-turn volume) to a high of 37 percent (three-lane approach, 40-percent right-turn volume).

Extrapolating these statistics to a nationwide fuel savings attributable to RTOR is tenuous, requiring some heroic and simplifying assumptions. However, it can provide some "order-of-magnitude" estimates for decision-making.

The best estimate of total fuel savings can be derived from the results of the grid network study, where it was found that an average fuel consumption savings of 2.6 percent to all vehicles would result from RTOR. It has been estimated by Courage that approximately 9 billion gallons of fuel are wasted annually at all intersections because of signal delay. (*Courage, Ken. "Reducing Fuel Consumption Through Traffic Signal Turning." Prepared for North Central Florida Regional Planning Council, March 1975.*) If true, then it can be assumed that RTOR would save 2.6 percent of that 9 billion gallons or 234 million gallons annually. This assumes that RTOR would be allowed at all intersections. A more realistic assumption is that 80 percent of the intersections would have RTOR; therefore, the savings would be about 187 million gallons of fuel annually. (In 1974, there was an estimated 75.1 billion gallons of fuel consumed by passenger vehicles alone.) At an average cost of 55¢/gallon for fuel, the "out-of-pocket" dollar savings to the public would be about \$102,300,000.

To test the reasonableness of this estimate, the fuel and resulting dollar savings estimated by the Virginia Highway Research Council can be extrapolated nationwide. (*Parker, Martin R.; Jordan, R. F., Jr.; Spencer, J. A.; Beale, M. D.; and Goodall, L. M. "Right-Turn-on-Red, A Report to the Governor and General Assembly of Virginia." Virginia Highway and Transportation Research Council, September 1975.*) In its study of RTOR, the Council estimated that 3.12 million gallons of fuel could be saved annually in Virginia with RTOR at an 80-percent implementation level. Virginia's population is about 4.8 million, which is 2.3 percent of the total U.S. population. If it is assumed that the number of signals are directly proportional to the population, and hence the RTOR fuel savings are proportional to the population, then the nationwide fuel savings would be about 136 million gallons of fuel (3.12 million gallons 2.3 percent). Although this estimate of fuel savings is lower than 187 million gallons noted earlier, it is at least of the same order of magnitude.

While it is nearly impossible to define the precise fuel savings attributable to RTOR, it is reasonable to assume that by permitting RTOR at nearly all intersections, a savings of 136 million to 187 million gallons of fuel could be realized each year.²

²Right-Turn-On-Red, pages 159-160.

Thus, this research project which was undertaken by the Federal Highway Administration reported that "RTOR was found to reduce delay, increase intersection throughput, and reduce fuel consumption and auto emissions."

STUDY DESIGN

In order to provide a data base for the assessment of the use or non-use of Montana's "right turn on red" law; and to make recommendations designed to increased the proper use of the right turn on red movement for the lowering of throughput time to conserve energy; and to calculate the attainable decreases in the consumption of petroleum products, it was necessary to collect and analyze data from Montana communities concerning these topics. It was also necessary to compare the Montana results with the results of the national study in order to make comparable energy savings estimates.

The data collected came from three major sources: (1) a field study involving right turn on red traffic observations; (2) a public opinion poll; and (3) existing traffic density studies. These data collection techniques are described in the following sections.

Right Turn On Red Traffic Observation

In order to gather firsthand data on the actual driver response to Montana's "right turn on red" law, two trained observers visited each of the thirteen largest cities of the State to make traffic observations and record data concerning driver use of the "right turn on red" law.

Following the selection of the thirteen cities, the Montana Highway Traffic Safety Division was consulted to identify two intersections in each community which have reasonably high levels of traffic, are signalized with the conventional traffic light, and are generally representative of signalized intersections in that community and section of the State. The individual from the Highway Traffic Safety Division who assisted in selection of the observation sites in each of the thirteen communities had firsthand knowledge, not only of each community, but also of the signalized intersections available for observation. Two intersections in each city were selected as preferred observation sites, with one or two back-up intersections identified in the event that the initial ones were not operating at the time scheduled for observation, due to such factors as nonoperating lights, various forms of construction that might block full use of the intersection, or other factors that would impede the normal flow of traffic.

Prior to the actual collection of the data, traffic observation methods, procedures, and forms were developed and tested to verify that the procedures would, in fact, result in the desired quality and quantity of observation data.

Two data collectors were then trained in the methods and procedures to be followed in making the traffic observations and recording the data. The same two observers gathered all field data in all thirteen cities to ensure consistency in the methods used and comparability of results. Both observers were assigned to gather information simultaneously at each of the selected intersections -- one during a two-hour peak time

and the other during a two-hour off-peak traffic time. The observers first timed the red signal length for each of the intersecting streets to obtain the base length of the red signal. Each then indicated the streets and corners being observed-- at a four-way intersection each data collector observed two corners. Using a digital stop watch, timing began as the traffic light turned red. When a vehicle stopped at the stop line for the red light, the number of seconds into the light interval was recorded. They observed blocks to turning, both cross-traffic and pedestrian; noted the time the driver was clear to turn; and when the driver actually turned. The number of all right turns made at that intersection in the two-hour observation period were recorded-- those made on the green signal as well as those made on red-- to provide data for estimating the percent of RTOR vehicles. Only the vehicle stopped at the stop line during each red signal was timed. As a vehicle which had been stopped at the stop line for the red light made a right turn on red and another vehicle took its place, the time of arrival of the second vehicle at the stop line was noted and the timing process for that potential RTOR was followed.

Following the collection of the traffic observation data, it was analyzed to determine the patterns of response of Montana drivers to the RTOR.

Due to the complexity of the observation, through traffic or intersection volume was estimated from prior traffic studies in each of the thirteen communities.

Public Opinion Poll

The second phase of the field study data collection was the public opinion survey. The same team of two persons who collected the data at the intersections in each of the thirteen largest cities also interviewed shoppers in each community regarding their opinions on RTOR, its safety/danger aspects, and if they used the RTOR when possible. In order to determine if the findings of the national study, reported in the previous section, were valid for Montana, questions used on the national study were also used for the Montana Energy Conservation Public Opinion Poll. Since another study of bikeway utilization was being conducted in the same communities at the same time, the bikeway questionnaire was combined with the right turn on red questionnaire in order to reduce the data collection costs and enable both studies to benefit from increased sample size.

The data collectors/interviewers interviewed shoppers, largely in public mall areas, concerning their opinions. Only residents of the specific city who had current Montana driver's licenses were interviewed. The interviewers were instructed to obtain an average of 250 completed questionnaires per community. The responses to the questionnaire were then tabulated and analyzed.

Traffic Density

In addition to the observational data on right turn on red at the intersections in the thirteen largest cities of Montana and the public opinion sample in each of the same thirteen cities, existing data on

traffic densities at the intersections observed in those cities were also utilized.

FINDINGS

It was determined that the thirteen largest cities of the State of Montana would be the sources of field test data, both for the right turn on red traffic observation and for the public opinion poll. For the purposes of this study the thirteen cities were placed in population categories to allow for the possibility that there may be differences in the utilization of the "right turn on red" law, depending upon the size of the city; or that there may be differences in the viewpoints expressed by residents of varying sizes of communities. The population categories were arbitrarily selected, based upon the fact that the size distribution for Montana cities seem to fall into natural clusters. The "over 60,000" category included Billings and Great Falls; Butte, Helena, and Missoula fell in the "20,000-60,000" category. Cities in the "10,000-20,000" range were Bozeman, Havre, and Kalispell; Anaconda and Miles City, being very nearly the same size, were in the "8,000-10,000" range; with Glendive, Lewistown, and Livingston in the "6,000-8,000" category. The 1970 federal census figures were used to categorize the cities by population.

The thirteen cities included in this study are listed by population category in Table 1, page 33. Also shown for each city are the number of intersections observed and the number of respondents to the

THIRTEEN LARGEST MONTANA CITIES
INCLUDED IN THE STUDY

POPULATION CATEGORY	CITY	NUMBER OF INTERSECTIONS OBSERVED	NUMBER OF OPINION POLL RESPONDENTS
Over 60,000	Billings	2	282
	Great Falls	2	284
20,000-60,000	Butte	2	255
	Helena	2	242
	Missoula	1	292
10,000-20,000	Bozeman	2	300
	Havre	2	270
	Kalispell	1	239
8,000-10,000	Anaconda	2	301
	Miles City	2	255
6,000-8,000	Glendive	1	242
	Lewistown	1	279
	Livingston	1	239
	Totals	21	3,480

TABLE 1. Cities Included in the Study, by Population Categories; Number of Intersections Observed; and Number of Opinion Poll Respondents in Each City.

public opinion poll. The findings from each of these data collection methods follow.

Right Turn On Red Traffic Observation

Two intersections were used for data collection in each of eight cities; and in each of the remaining cities, one intersection was observed -- for a total of twenty-one intersections. The specific intersections used for observation and recording of the number of vehicles making right turns and right turns on red in each of the thirteen cities are indicated on the individual city maps in Appendix A.

The observations were divided between peak and off-peak traffic periods. For the purposes of this study, periods falling between 6:30 and 9:00 a.m. were defined as "peak" periods, whereas those between the hours of 9:00 a.m. and 12:00 noon were defined as "off-peak" traffic periods. Of the twenty-one 2-hour observations, twelve were made during periods of peak traffic and nine were made at periods of off-peak traffic. Copies of the forms used in the collection and recording of the observational data may be found in Appendix B.

The number of right turns made by motorists during peak and off-peak traffic; the number of right turns on red during peak and off-peak periods for each of the population categories of cities; and the percentage ratios between the total number of right turns and the number of right turns on red are indicated in Table 2, page 35. It may be noted that only peak periods were observed in the cities of 6,000-8,000 population. In a comparison of the percent of right turns on red

POPULATION OF CITIES	NUMBER OF RIGHT TURNS			NUMBER OF RTOR			% RTOR IS OF TOTAL RIGHT TURNS		
	Peak	Off- Peak	Total	Peak	Off- Peak	Total	Peak	Off- Peak	Total
Over 60,000	1117	542	1659	277	185	462	24.8	34.1	27.8
20,000-60,000	724	1081	1805	192	173	365	26.5	16.0	20.2
10,000-20,000	630	875	1505	194	228	422	30.8	26.1	28.0
8,000-10,000	267	344	611	103	81	184	38.6	23.5	30.1
6,000-8,000	701	---	701	116	---	116	16.5		16.5
TOTALS	3439	2842	6281	880	667	1549	25.6	23.5	24.7

TABLE 2. Distribution of RTOR and Total Right Turns Observed.

between the peak and off-peak periods, the data reveal that in the two largest cities of the State, 24.8% of the peak period right turns were made on red; whereas for the same cities, 34.1% of the off-peak right turns were made on red. This is a reversal of the relationships observed in the other clusters of cities, where the peak periods experienced the highest ratio of right turns on red to total right turns. The percentage figures ranged from a low of 16.5% to a high of 38.6% for peak periods and a low of 16.0% to 34.1% in off-peak periods; however, when the total number of peak period right turns on red are compared to the total number of off-peak period right turns on red, one notes that there is a very slight difference, 25.6% to 23.5% -- for an over-all total of 24.7%. Thus it would appear from these data that approximately one-fourth of all right turns observed were right turns on red.

In order to determine the amount of energy saved by utilizing the RTOR law, it was necessary to calculate the number of seconds of idling time saved by vehicles making right turns on red. An inspection of Table 3, page 37, would indicate that, in most cases, more total seconds were saved during hours of peak traffic than during off-peak hours; and likewise, the number of RTOR vehicles during peak hours was most often greater than during off-peak hours. The number of seconds saved per RTOR vehicle in the largest cities was 26.56 during peak traffic and 16.55 seconds during off-peak traffic, for a combined savings of 22.55 seconds per RTOR vehicle. This 10-second difference between peak and off-peak periods is significantly larger than the

POPULATION OF CITIES	SECONDS SAVED			NUMBER OF RTOR VEHICLES			SECONDS SAVED PER RTOR VEHICLE		
	Peak	Off- Peak	Total	Peak	Off- Peak	Total	Peak	Off- Peak	Combined Peak and Off-Peak
Over 60,000	7358	3061	10419	277	185	462	26.56	16.55	22.55
20,000-60,000	2360	1679	4039	192	173	365	12.29	9.70	11.07
10,000-20,000	2050	2306	4356	194	228	422	10.57	10.11	10.32
8,000-10,000	975	868	1843	103	81	184	9.47	10.72	10.02
6,000-8,000	1403	—	1403	116	—	116	12.09	—	12.09
TOTALS	14146	7914	22060	882	667	1549	16.04	11.87	14.24

TABLE 3. Time Saved By RTOR Per 2-Hour Observation, by City Size.

differences experienced in the other cities. It may also be noted that the combined peak and off-peak number of seconds saved per RTOR vehicle in the largest cities was about twice that saved in each of the other city categories. The number of seconds saved per RTOR vehicle, under combined peak and off-peak conditions, range from 10.02 to 22.55, with an average of 14.24 seconds saved per RTOR vehicle. The average peak/off-peak seconds saved varied about 4 seconds, with the peak period being the higher.

In order to ascertain if the number of lanes of traffic influenced the amount of time saved per RTOR vehicle, the intersections observed in this study were classified according to the number of lanes of traffic being utilized during the period of observation. A summary of the results of this examination may be found in Table 4, page 39. A "2 & 2" type intersection would be one which has two intersecting streets of two lanes each; a "4 & 2" intersection would be an intersection of one four-lane street and one two-lane street. It may be noted that the seconds saved per RTOR vehicle for the 2 & 2 streets was the lowest of all classifications at 8.3 seconds. The 4 & 2 and the 6 & 4 were very nearly the same at 10.1 and 11.3, respectively. However, the 4 & 4 was significantly higher than all others, at 24.8 seconds saved per RTOR vehicle. The composite savings per RTOR vehicle for all intersections, both peak and off-peak, was 14.2 seconds. It would appear from this data that in situations where it is possible to continue through the intersection, either in a straight trajectory or making a right turn in one's own lane, the traffic will

NUMBER OF LANES OF TRAFFIC	SECONDS SAVED			NUMBER OF RTOR VEHICLES			SECONDS SAVED PER RTOR VEHICLE		
	Peak	Off- Peak	Total	Peak	Off- Peak	Total	Peak	Off- Peak	Combined Peak and Off-Peak
2 & 2	1185	657	1842	131	92	223	9.0	7.1	8.3
4 & 2	4087	3961	8048	408	385	793	10.0	10.3	10.1
4 & 4	8874	2427	11301	343	113	456	25.9	21.4	24.8
6 & 4	—	869	869	—	77	77	—	11.3	11.3
TOTALS	14146	7914	22060	882	667	1549	16.0	11.9	14.2

TABLE 4. Time Saved By RTOR Per 2-Hour Observation, By Number of Lanes of Traffic.

flow more smoothly than in situations where through traffic and right turn on red are mixed in the same line or, in the case of the 4 & 2 and the 6 & 4, the turning from one street to the other requires a lane change. This phenomenon was substantiated in the national study. It is possible that under the 4 & 4 intersection configuration, one of the lanes served primarily as a through lane and the other lane served as either a right turn lane or as a combination of right turn and through.

In order to be able to project the number of right turns on red from the average daily traffic, it was necessary to examine the existing data for average daily traffic and number of right turns at the intersections observed. The table in Appendix C presents data from the Montana Highway Traffic Safety Division concerning average daily traffic and densities for the locations observed in this study, by 2-hour periods comparable to those used during this study though not taken on the same date. The information available provided not only the average daily traffic and the number making right turns but also the number making left turns at the intersections and the number going straight.

The information in Appendix C was consolidated by city size in Table 5, page 41. The computations reveal that 16.4% of all of the traffic through the intersections made left turns; 14.8% made right turns; while 68.8% followed a straight path through the intersections. An examination of the right-hand column in Table 5, which gives the percent the right turn is of the total ADT, reveals that there was a slight increase in the percent of right turns as the size of the

POPULATION OF CITIES	ADT BY DIRECTION			TOTAL ADT	% RIGHT TURN IS OF TOTAL ADT
	Left Turn	Straight	Right Turn		
Over 60,000	13,077	51,872	10,687	75,636	14.1
20,000-60,000	20,096	67,880	14,449	102,425	14.1
10,000-20,000	10,653	52,979	11,430	75,062	15.2
8,000-10,000	3,803	23,242	4,871	31,916	15.3
6,000-8,000	3,917	20,116	4,898	28,931	16.9
TOTAL	51,546	216,089	46,335	313,970	14.8
PERCENTAGE DISTRIBUTION	16.4	68.8	14.8		

TABLE 5. Distribution Of Average Daily Traffic By Direction And Size Of City.

cities became smaller. Although a tendency would seem to be indicated by the data presented, it is not possible to state unequivocally that there is an inverse relationship between city size and the percent of people making right turns out of the total average daily traffic.

During the observation, the total through and left turn traffic was observed and recorded for two of the field study locations. One of these was in Butte at Harrison and Amherst, where the straight and left turn traffic from the north on Harrison for the 2-hour period totalled 1,143 and the straight traffic from the south on Harrison totalled 1,006. This compares with the combined straight and left turn of 1,330 from the north and 1,290 from the south reported in Appendix C. The other site where through and left turn traffic was counted at the time the RTOR tallies were being made was in Billings at Conway and Exposition Drive. The through traffic and left turn from the north on Conway was tallied at 2,010; the through traffic from the south on Conway was 1,027; and the left turn traffic from the east on Exposition Drive was 267. These figures compare with 1,976; 1,015; and 246, respectively, as listed in the average daily traffic and densities table in Appendix C. Thus it would appear that the traffic during the periods of data collection for this study followed very closely the patterns of the 2-hour traffic densities and the average daily traffic projections provided by the Highway Traffic Safety Division in Helena.

A comparison of the data obtained from this Montana study with that reported in the national study reveals some interesting parallels. The national study reported that where the RTOR rule is generally

permissive, as is the case in Montana, 21.2% of all right turns are RTOR. This compares with 24.7% for the twenty-one intersections in thirteen cities included in this study. Thus it would appear that the utilization rate of the RTOR rule by Montana drivers is equal to, or possibly slightly higher than, the national rate. Data obtained in this study revealed that the delay savings for Montana drivers utilizing the RTOR rule was 14.2 seconds per vehicle; the average savings was 3.5 seconds for all right-turning vehicles. In the national study, the over-all right turn delay savings per right-turning vehicle was reported as 4.5 seconds. Thus it would appear that the Montana savings, as revealed in this study, are comparable to those reported in the national study.

Public Opinion Poll

A second major portion of this study involved the gathering of data via a public opinion poll. As stated earlier, the public opinion poll was administered to persons in each of the thirteen cities included in this study. For the purposes of this study it was ascertained that a sample size with an average of 250 respondents per city would be adequate. In practice, this number was exceeded, with an average of about 268 persons responding with usable questionnaires. (See Table 1, page 33.) No attempt was made to obtain equal samples of males and females, nor of particular age distributions for the opinion poll respondents. A copy of the questionnaire utilized in the opinion poll may be found in Appendix D. As was noted earlier, the opinion poll portion of the RTOR

study was combined with another study concerning bike utilization and, therefore, the questionnaire includes items on both topics.

In order to correlate the findings of this portion of the study with the results reported in the national study entitled "Right-Turn-On-Red", some of the same questions were used in the Montana study as were listed for the national study. This included the categorization of respondents by age groups. See Table 6, below:

POPULATION OF CITIES	NUMBER OF RESPONDENTS BY AGE GROUP					PERCENTAGE DISTRIBUTION
	Under 20	21-40	41-60	Over 60	Total	
Over 60,000	121	179	159	107	566	16.3
20,000-60,000	114	296	251	128	789	22.7
10,000-20,000	145	263	274	127	809	23.2
8,000-10,000	116	140	191	109	556	16.0
6,000-8,000	75	177	279	229	760	21.8
Totals	571	1055	1154	700	3480	
Percentage Distribution	16.4	30.3	33.2	20.1		

TABLE 6. Distribution Of Public Opinion Poll Respondents By Age And Size Of City.

An examination of the information in Table 6 reveals that approximately one-third of the respondents were between the ages of 21 and 40; another one-third between the ages of 41 and 60; with the remaining third split between those under 20 and those reporting their ages as over 60. It should be noted that all persons responding to this poll

stated that they were residents of the respective city in which the poll was taken and were holders of current Montana driver's licenses. The distribution of respondents by city size is also indicated in Table 6. The categories "over 60,000" and "8,000-10,000" for city size each had two communities in the sample, whereas the other categories had three cities each. This accounts for the slight variation in the percentage distribution among the various categories of cities.

Questions 15 through 20 on the questionnaire dealt specifically with RTOR. Tables showing the distribution of the number of responses to each of these questions, by population of cities and age of respondents are included in Appendix E.

The question, "What is the state law for turning right on a red light?", was included to determine if the motorists of Montana were aware of the RTOR law. The response distribution to this question, by population of cities, is shown in Table 7:

What is the state law for turning right on a red light?

POPULATION OF CITIES	RESPONSE PERCENT		
	<i>Prohibited</i>	<i>Generally Permitted</i>	<i>Permitted by Sign Only</i>
Over 60,000	0.0	94.0	6.0
20,000-60,000	0.0	96.3	3.7
10,000-20,000	0.0	93.4	6.6
8,000-10,000	0.0	90.3	9.7
6,000-8,000	0.0	92.0	8.0
TOTAL	0.0	93.4	6.6

TABLE 7. Percentage Distribution Of Responses To Public Opinion Poll Question 15.

As may be noted, 93.4% of all respondents indicated that RTOR is "generally permitted." No one answered "prohibited" and those in the smaller size communities responded "permitted by sign only" slightly more often than those in the larger communities. A comparison of the responses by age group, Figure 11, page 47, shows that 11.6% of the "under 20" age drivers did not know the state law concerning RTOR. The 93.4% of all drivers in the survey who were aware of the state law compares favorably with the survey results obtained on the national study which reported that 92% were aware of the RTOR rule. (See Figure 7, page 21.)

PUBLIC OPINION POLL RESPONSES BY AGE GROUP

What is the state law for turning right on a red light?

- 1 - prohibited
- 2 - generally permitted
- 3 - permitted by sign only

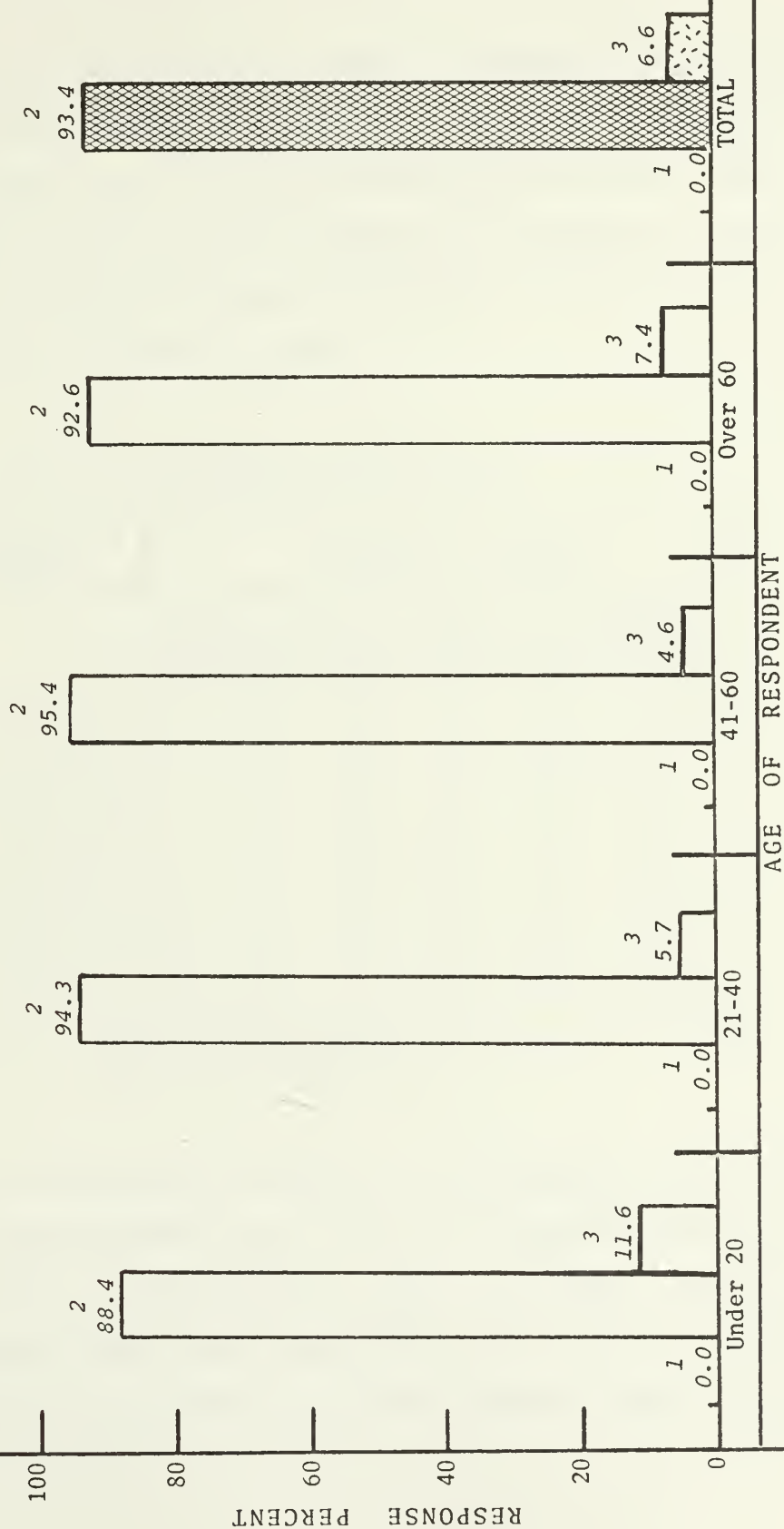


FIGURE 11. Percentage Distribution Of Responses To Public Opinion Poll Question 15.

In response to the question, "When it is possible to turn right on a red light, how often do you do it?", 97% of all respondents answered, "most of the time" with the remaining 3% stating, "sometimes." Those living in the two largest cities responded, "most of the time" in 99.5% of the cases, which dropped to about 95% in the smaller cities. See Table 8, below.

*When it is possible to turn right on a red light,
how often do you do it?*

POPULATION OF CITIES	RESPONSE PERCENT		
	<i>Hardly Ever</i>	<i>Sometimes</i>	<i>Most Of The Time</i>
Over 60,000	0.0	0.5	99.5
20,000-60,000	0.0	1.8	98.2
10,000-20,000	0.0	3.0	97.0
8,000-10,000	0.0	5.4	94.6
6,000-8,000	0.0	4.3	95.7
TOTAL	0.0	3.0	97.0

TABLE 8. Percentage Distribution Of Responses To Public Opinion Poll Question 16.

The age distribution of responses to this question, Figure 12, page 49, shows that there were virtually no differences among the various age groups, with 97% reporting, "most of the time." This 97% rate for Montanans is significantly above that found in the national study where only 76% of the general rule states responded, "most of the

PUBLIC OPINION POLL RESPONSES BY AGE GROUP

When it is possible to turn right on a red light,
how often do you do it?

1 - hardly ever
2 - sometimes
3 - most of the time

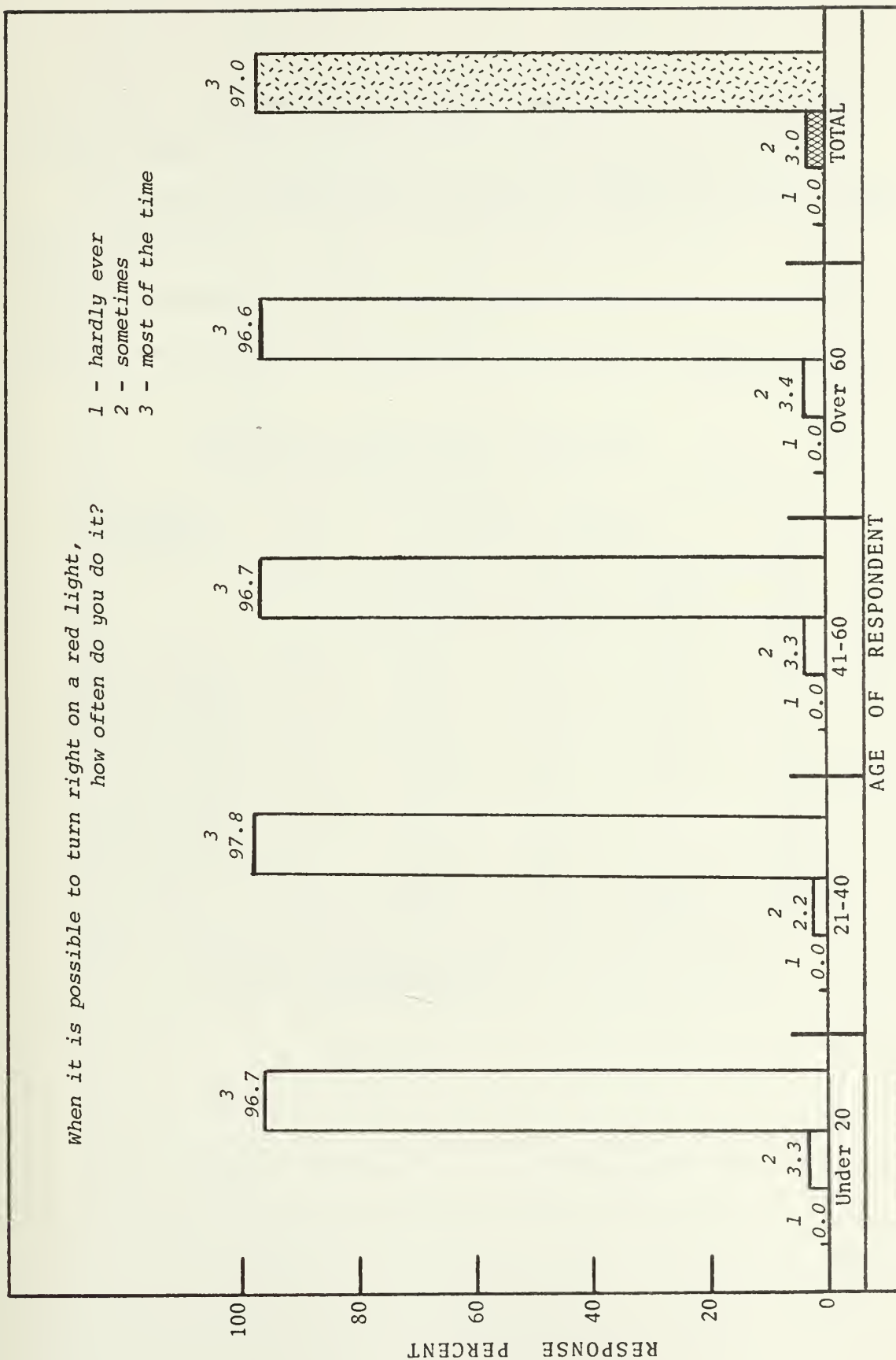


FIGURE 12. Percentage Distribution Of Responses To Public Opinion Poll Question 16.

time"; 19%, "sometime"; and 5% stated, "hardly ever." (Please see Figure 8, page 22.

The question, "Do you feel that making a right turn on a red light saves gasoline?", was answered affirmatively by 99.7% of all those polled. See Table 9. There were no significant differences by age groups in response to this question, as revealed in Figure 13, page 51.

*Do you feel that making a right turn
on a red light saves gasoline?*

POPULATION OF CITIES	RESPONSE PERCENT	
	<i>Yes</i>	<i>No</i>
Over 60,000	100.0	0.0
20,000-60,000	99.7	0.3
10,000-20,000	99.5	0.5
8,000-10,000	99.5	0.5
6,000-8,000	99.7	0.3
TOTAL	99.7	0.3

TABLE 9. Percentage Distribution Of Responses To Public Opinion Poll Question 17.

PUBLIC OPINION POLL RESPONSES BY AGE GROUP

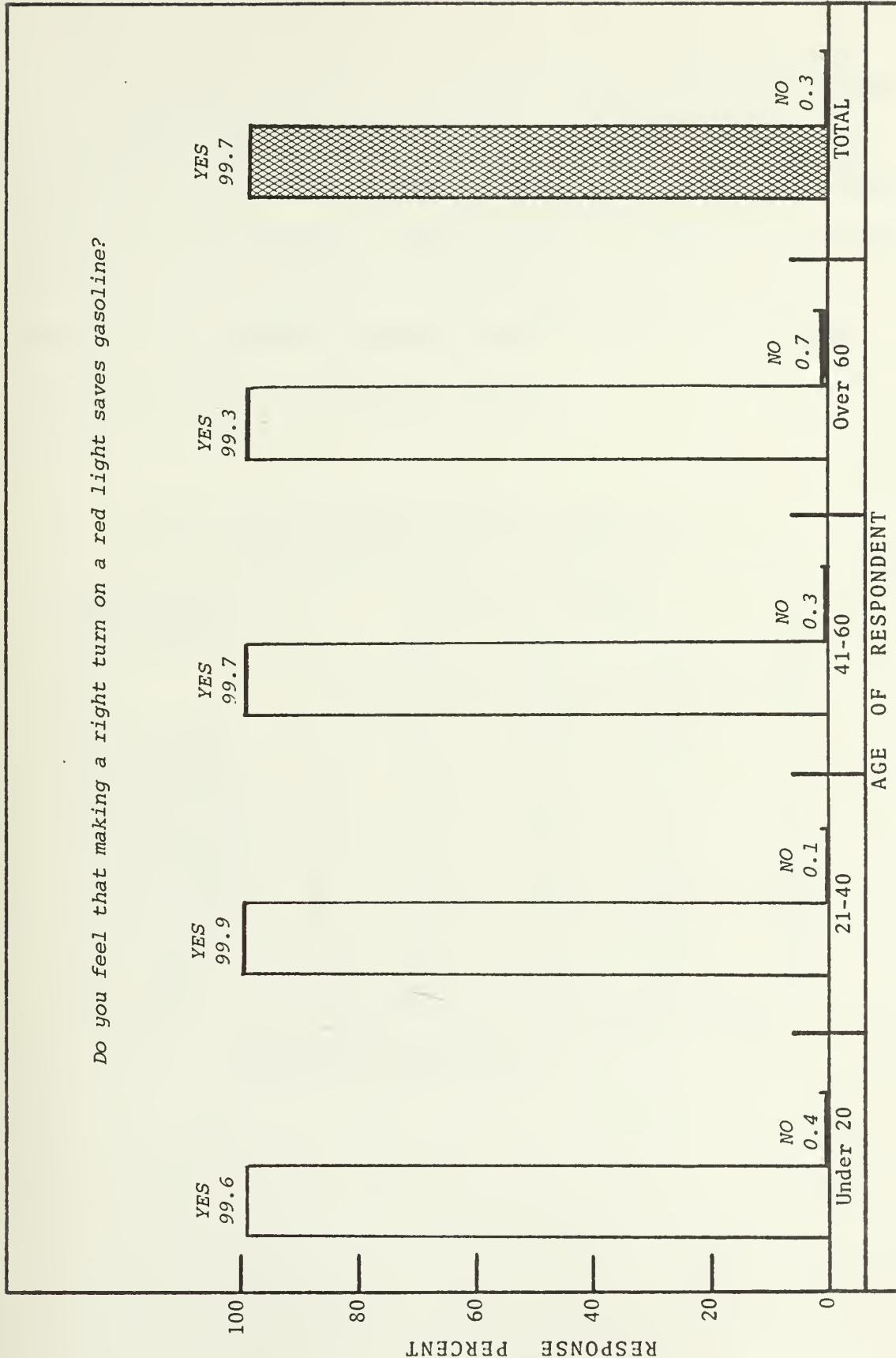


FIGURE 13. Percentage Distribution Of Responses To Public Opinion Poll Question 17.

The responses given to the question, "Do you feel that permitting right turns on red is dangerous to you as a driver?", indicate that 99.7% said, "no," (Table 10) with virtually no differences in response percent by city population. There were also no significant differences among responses by the age of respondent as indicated in Figure 14, page 53. The comparable responses from the national study were 93% "no" and 7% "yes." See Figure 10, page 24.

*Do you feel that permitting right turns on red
is dangerous to you as a driver?*

POPULATION OF CITIES	RESPONSE PERCENT	
	<i>Yes</i>	<i>No</i>
Over 60,000	1.1	98.9
20,000-60,000	0.5	99.5
10,000-20,000	0.1	99.9
8,000-10,000	0.0	100.0
6,000-8,000	0.0	100.0
TOTAL	0.3	99.7

TABLE 10. Percentage Distribution Of Responses To Public Opinion Poll Question 18a.

PUBLIC OPINION POLL RESPONSES BY AGE GROUP

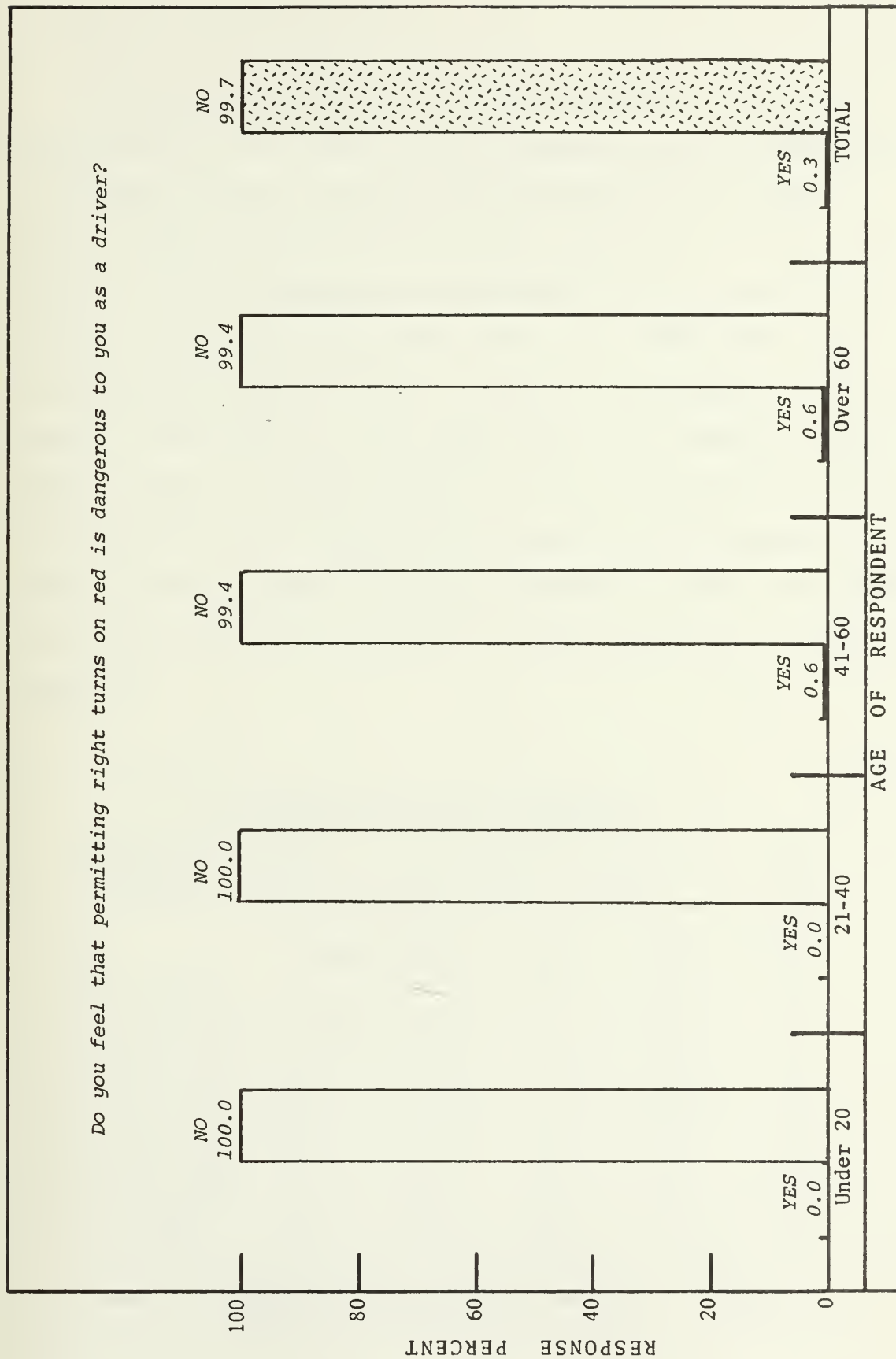


FIGURE 14. Percentage Distribution Of Responses To Public Opinion Poll Question 18a.

The response pattern for the associated question, "Do you feel that permitting right turns on red is dangerous to you as a pedestrian?", is somewhat different in that only 89% responded with "no," with an over-all total response of 11% for "yes." See Table 11, below. The percent of "yes" responses range from 5.8% for cities in the "20,000-60,000" category to 14.1% for the cities in the "6,000-8,000" range. An examination of the age pattern responses to this question, Figure 15, page 55, shows that the two age groups under 40 had identical percentages at 92.5%. It dropped somewhat for the 41-60 age group, to 87.5%, and declined further to 83.4% for those over 60. In the national study, 76% of those from general rule states answered, "no", while 24% stated that they did feel it was dangerous to them as pedestrians. (Figure 10, page 24.)

*Do you feel that permitting right turns on red
is dangerous to you as a pedestrian?*

POPULATION OF CITIES	RESPONSE PERCENT	
	<i>Yes</i>	<i>No</i>
Over 60,000	11.3	88.7
20,000-60,000	5.8	94.2
10,000-20,000	13.6	86.4
8,000-10,000	9.9	90.1
6,000-8,000	14.1	85.9
TOTAL	11.0	89.0

TABLE 11. Percentage Distribution Of Responses To Public Opinion Poll Question 18b.

PUBLIC OPINION POLL RESPONSES BY AGE GROUP

Do you feel that permitting right turns on red is dangerous to you as a pedestrian?

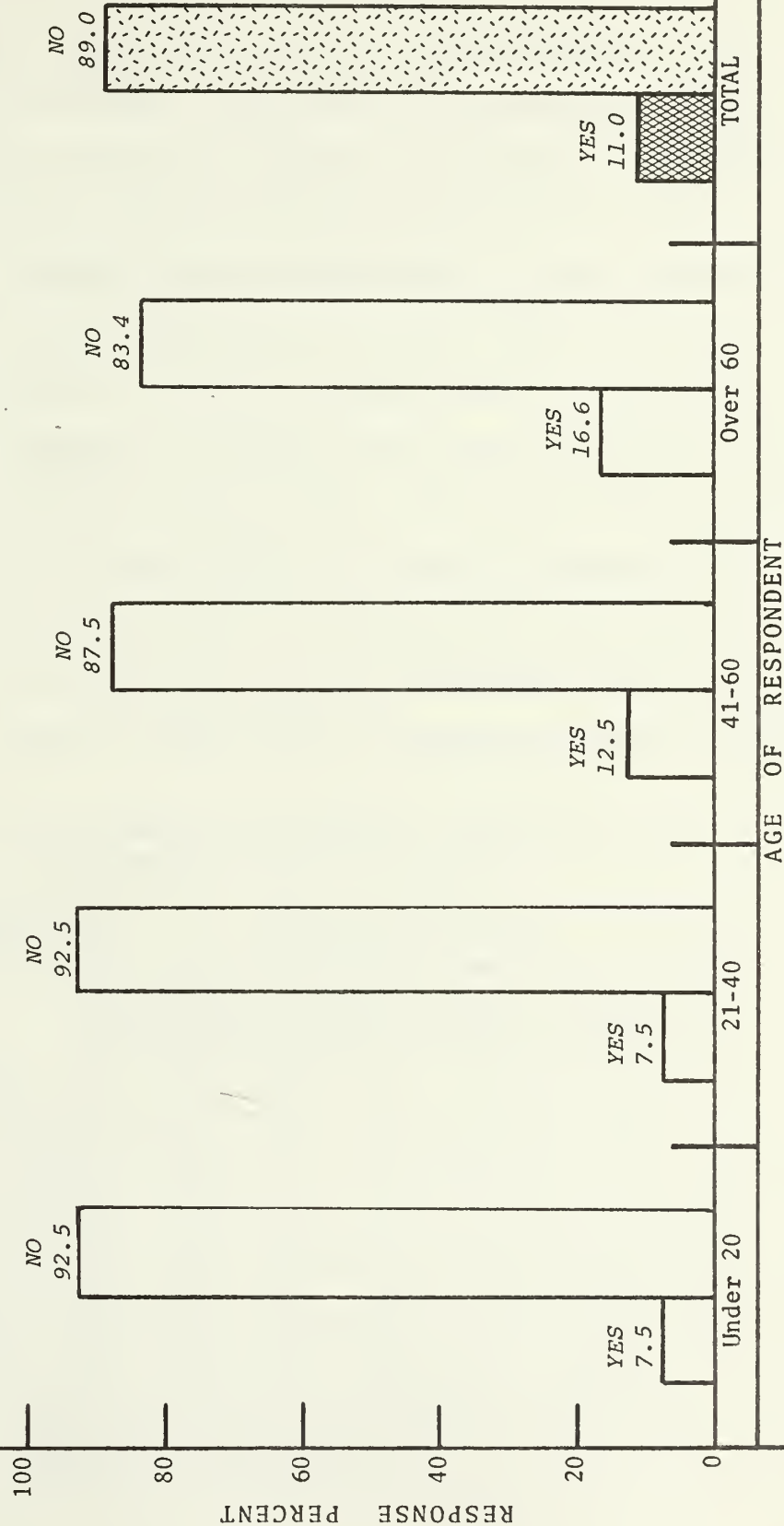


FIGURE 15. Percentage Distribution Of Responses To Public Opinion Poll Question 18b.

The drivers in the smallest cities in the sample appear to be more pressured into making a right turn on red by impatient drivers behind them than is the case for drivers in the other cities sampled. See Table 12, below. In the cities from 6,000-8,000, 89% of the drivers stated, "never," which was approximately 5 or more percentage points below the driver respondents in the other cities. One-tenth of 1%, or one driver in a thousand, indicated that they thought they were frequently pressured by impatient drivers behind them, with 6.4% feeling they occasionally were pressured. These statistics would seem to indicate that the Montana drivers do not feel as pressured into making right turns on red by drivers behind them as is the case for drivers in other portions of the nation, as indicated in the national study, Figure 9, page 23, where 24% of the general rule states responded,

*Are you ever pressured into making a right turn on red
by impatient drivers behind you?*

POPULATION OF CITIES	RESPONSE PERCENT		
	<i>Frequently</i>	<i>Occasionally</i>	<i>Never</i>
Over 60,000	0.0	3.7	96.3
20,000-60,000	0.4	5.8	93.8
10,000-20,000	0.0	4.7	95.3
8,000-10,000	0.0	5.9	94.1
6,000-8,000	0.1	10.9	89.0
TOTAL	0.1	6.4	93.5

TABLE 12. Percentage Distribution Of Responses To Public Opinion Poll Question 19.

"sometimes," and 2% responded, "most of the time," with only 74% in the "hardly ever" category. The responses to the question of feeling pressured into making right turns on red indicated some possible differences by age of respondents, Figure 16, page 58. For example, the two categories under 40 responded, "never," in 95+% of the cases, whereas the over 60 was slightly less than 90%, with all of the "frequently" responses coming from those over 60.

PUBLIC OPINION POLL RESPONSES BY AGE GROUP

Are you ever pressured into making a right turn on red
by impatient drivers behind you?

- 1 - frequently
- 2 - occasionally
- 3 - never

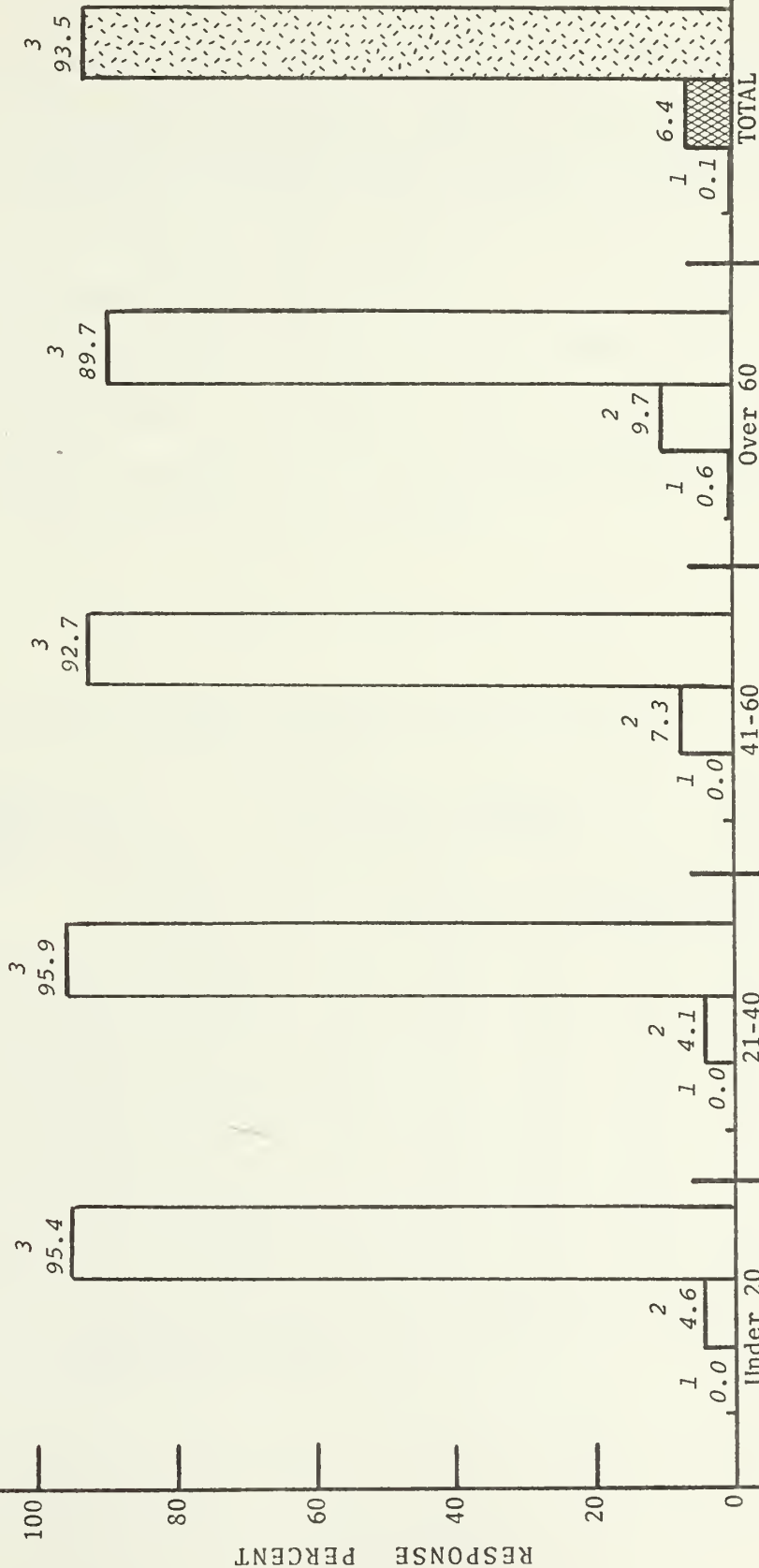


FIGURE 16. Percentage Distribution Of Responses To Public Opinion Poll Question 19.

The final question in this survey was, "How do you feel about the state law for right turn on a red light?", with the forced-choice responses being "support it," "neutral," and "opposed." 99.6% of the Montana drivers polled indicated that they support the state law. Three-tenths of 1% were neutral and one-tenth of 1% over-all were opposed. All of the opposition stated was from the three cities in the "20,000-60,000" category. See Table 13, below. Figure 17, page 60, reveals that the four-tenths of 1% who stated they were opposed to the state law were in the "over 60" category.

*How do you feel about the state law for right turn
on a red light?*

POPULATION OF CITIES	RESPONSE PERCENT		
	<i>Support It</i>	<i>Neutral</i>	<i>Opposed</i>
Over 60,000	100.0	0.0	0.0
20,000-60,000	99.4	0.2	0.4
10,000-20,000	99.4	0.6	0.0
8,000-10,000	99.3	0.7	0.0
6,000-8,000	100.0	0.0	0.0
TOTAL	99.6	0.3	0.1

TABLE 13. Percentage Distribution Of Responses To Public Opinion Poll Question 20.

PUBLIC OPINION POLL RESPONSES BY AGE GROUP

1 - support it
2 - neutral
3 - opposed

How do you feel about the state law for right turn on a red light?

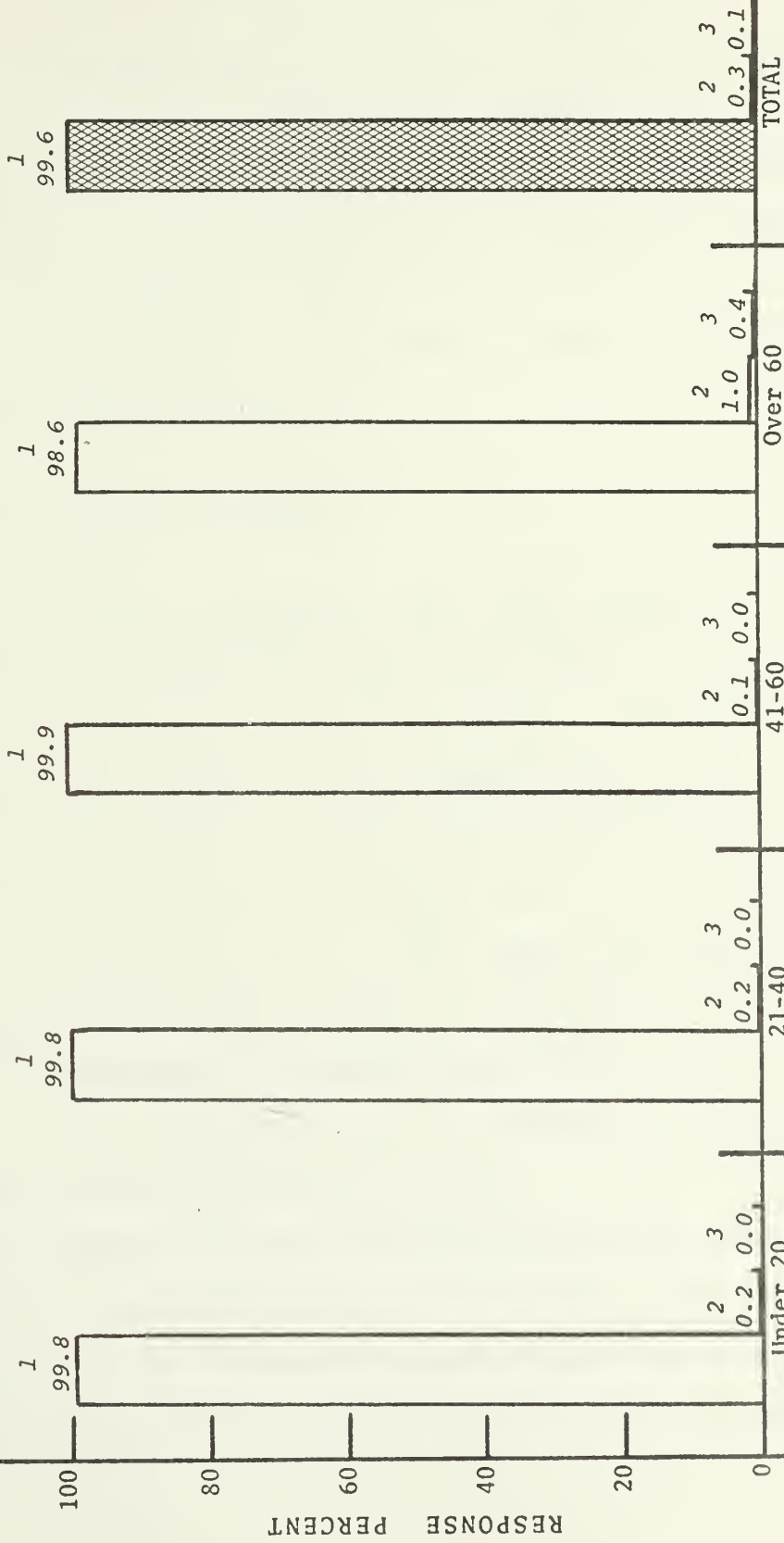


FIGURE 17. Percentage Distribution Of Responses To Public Opinion Poll Question 20.

Thus it would appear from the results of the public opinion poll that the drivers of Montana support the state law permitting a right turn on red; do not view it as particularly dangerous; feel that they take advantage of the reduced delay time by utilizing the RTOR whenever possible; and feel that it helps save fuel. There were really no marked differences revealed in the pattern of responses either by age distribution or by size of city.

ENERGY SAVINGS FROM RTOR UTILIZATION

The basis for making projections of fuel energy savings in this study was based on the Right-Turn-On-Red study prepared for the Federal Highway Administration; the work of Courage and the estimation made by the Virginia Highway Research Council as reported in the national Right-Turn-On-Red study (see pages 25-27); and the fact that the results of this Montana study, both the ROTR observations and the public opinion poll, correlate very highly with the national Right-Turn-On-Red study.

The Right-Turn-On-Red study estimated that 187 million gallons of fuel could be saved nationally by allowing RTOR at 80% of the intersections (see page 27). The comparable estimate computed by the Virginia Highway Research Council was 136 million gallons.

Montana's population of about 700,000 (1970 census) is about 0.34% of the total United States population. If one assumes, as was done in the Virginia study, that the number of traffic signals are directly proportional to the total U.S. population, the savings in fuel due to

allowing RTOR at 80% of the signalized intersections would be, for Montana, 0.34% of the national total. This would result in a savings of from 462,000 to 636,000 gallons of fuel per year for Montana depending upon which U.S. estimate (136 million or 187 million gallons) was used. It is estimated that approximately 20% of all vehicle miles driven in Montana are in the urban areas and the remaining 80% in rural sections of the State. Therefore, in any calculation of traffic delay savings due to RTOR, less than 20% of the total driving in the State will be affected by the RTOR law and, consequently, the amount of fuel saved will probably be less in a state like Montana than it would be in one of the more urban states where a much higher percentage of the total mileage is driven on urban streets. Thus the lower figure, 462,000 gallons, is assumed to be the maximum realistic savings. This translates into a maximum potential savings of 0.058×10^{12} BTU's from utilizing RTOR in Montana as compared to an absence of an RTOR law.

CONCLUSIONS AND RECOMMENDATIONS

On the basis of the data obtained from the traffic observations and the responses to the public opinion poll in the thirteen largest cities of Montana, as well as a comparison of those data with the results of the national Right-Turn-On-Red study, the following conclusions and recommendations are presented.

Conclusions

Conclusions drawn from this study are:

- * The results of the Montana RTOR study correlate highly with those of the national Right-Turn-On-Red study completed for the Federal Highway Administration.
- * RTOR significantly increases intersection throughput.
- * RTOR reduces delay, gasoline consumption, and vehicle emissions.
- * Turn lanes and turn pockets used in conjunction with RTOR reduce turn delay and increase throughput.
- * Montana drivers are generally knowledgeable of the State's RTOR law and feel they perform the movement most of the time when possible.
- * Montana drivers support the RTOR law and view it as a relatively safe maneuver, more so for driver than pedestrian.
- * Montana drivers view RTOR as a means of saving gasoline.
- * Fuel savings projections used in the national study are also applicable to Montana.

Recommendations

In order to increase the utilization of RTOR, increase intersection throughput, and thereby conserve energy, the following recommendations are made:

- * That where possible the number of lanes of traffic on higher volume streets be increased, particularly for present two-lane streets.
- * That turn lanes or pockets, both right and left, be provided where possible.
- * That in multilaned intersection approaches specific lanes be identified and clearly marked as turn lanes and/or as through lanes.

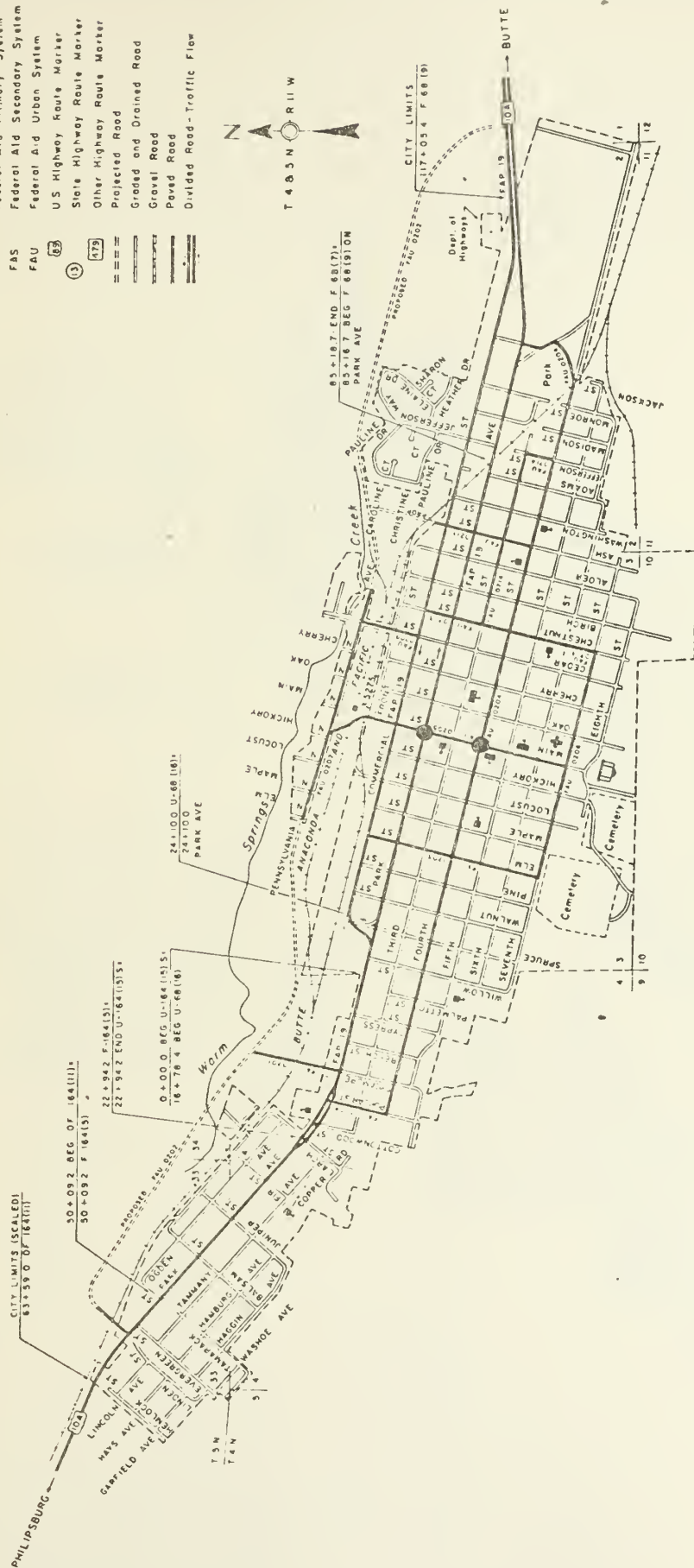
- * That the State driver's manual be examined and modified where indicated to ensure proper instruction for new drivers in RTOR and left turns.
- * That driver education and training programs include instruction in the proper and safe use of turn features including RTOR.
- * That the general public, both drivers and pedestrians, be periodically reminded of the meaning, requirements, and energy saving benefits of proper RTOR utilization.

APPENDIX A

- Corporate Boundary Line
 Central Business District
 Non-existent Dedicated Street
 Railroad and Station
 Elevation
 Court House
 Post Office
 Hospital
 Elementary School
 High School

FEDERAL AID HIGHWAY SYSTEMS

- FAI
 Federal Aid Interstate System
 FAP
 Federal Aid Primary System
 FAS
 Federal Aid Secondary System
 FAU
 Federal Aid Urban System
 U.S. Highway Route Marker
 State Highway Route Marker
 Other Highway Route Marker
 Projected Road
 Graded and Drained Road
 Gravel Road
 Paved Road
 Divided Road - Traffic Flow



CITY PLAT ANACONDA DEER LODGE COUNTY MONTANA

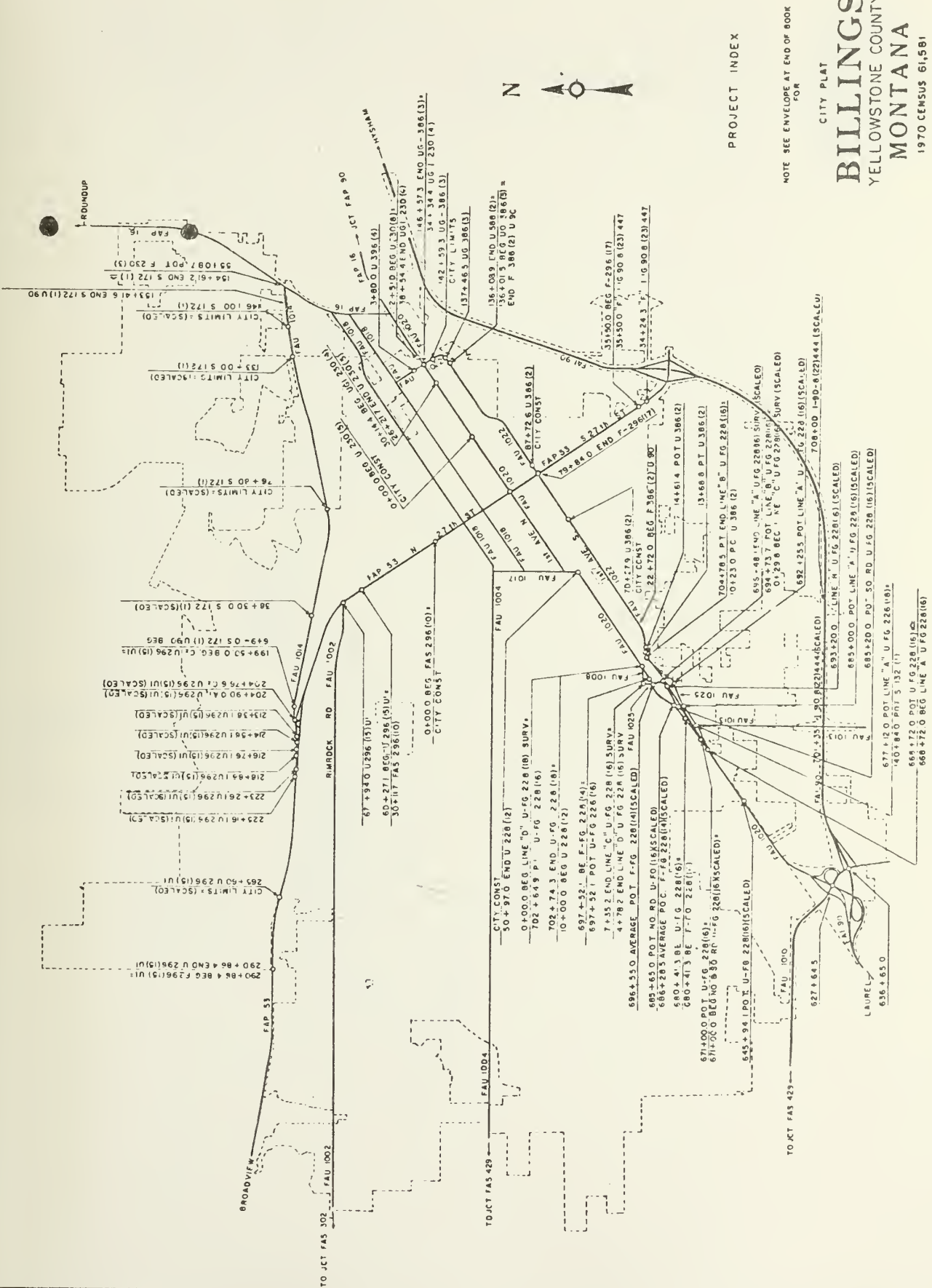
1970 CENSUS 9,771

SCALE IN FEET
0 1000 2000

REVISED DEC 31, 1976

196, 6 1971 USGS BASE

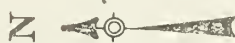
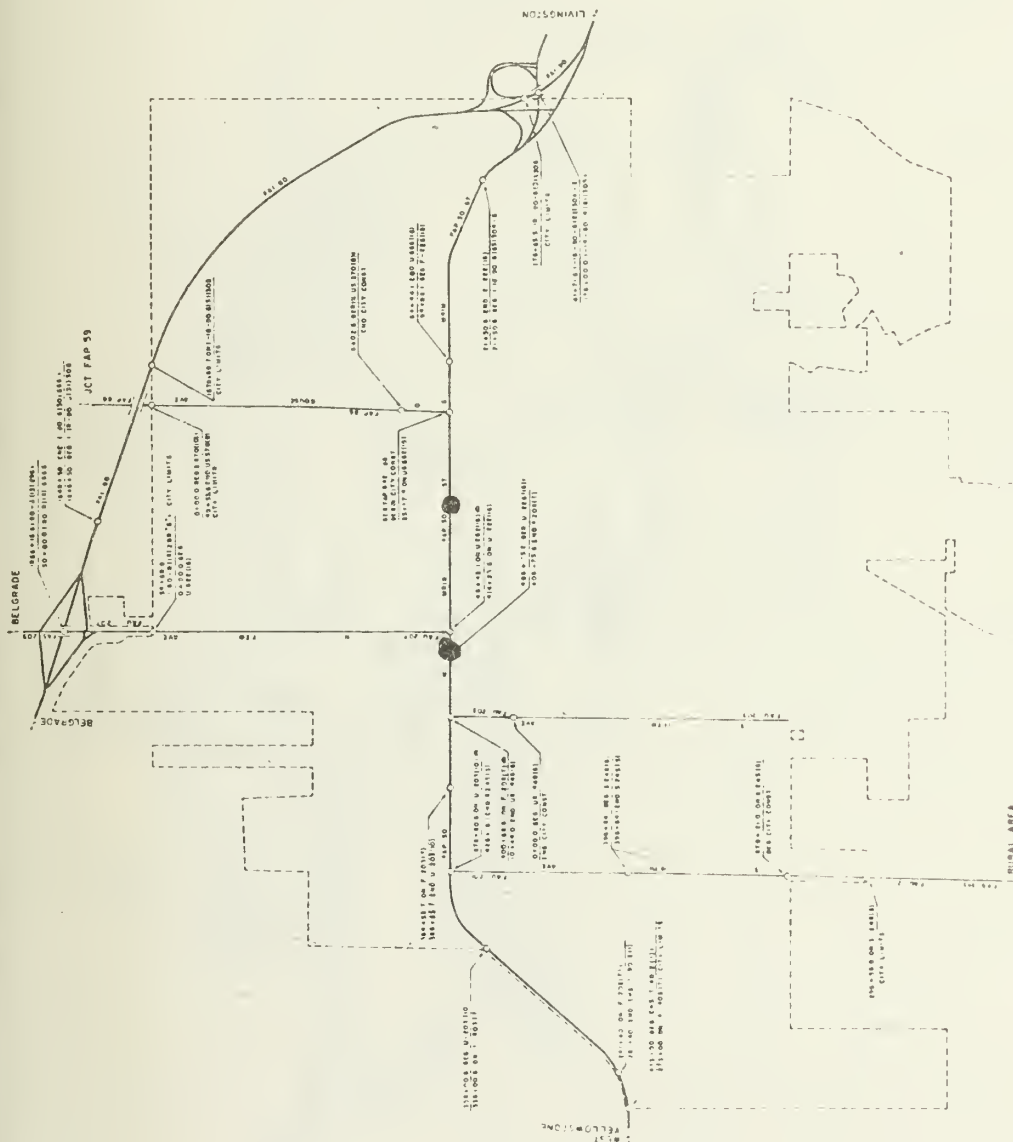
Copies of this map are available at
 general cost from the Montana Department
 of Highways - Helena, Montana 59601



PROJECT INDEX

NOTE SEE ENVELOPE AT END OF BOOK FOR

CITY PLAT
BILLINGS
YELLOWSTONE COUNTY
MONTANA
1970 CENSUS 61,581



PROJECT INDEX

NOTE: SEE ENVELOPE AT END OF BOOK FOR

CITY PLAT
BOZEMAN
 GALLATIN COUNTY
MONTANA
 1970 CENSUS 18,670

FEDERAL AID HIGHWAY SYSTEMS

PROJECTED ROAD
GRADED AND DRAINAGE ROAD
PAVED OR STONE ROAD
PAVEL ROAD

DIVIDED ROAD - TRAFFIC FLOW
FBI
FPI
FAP
FAS

FEDERAL AID INTERSTATE SYSTEM
FEDERAL AID PRIMARY SYSTEM
FEDERAL AID SECONDARY SYSTEM
INTERSTATE ROUTE MARKER
US NUMBERED ROUTE MARKER
STATE ROUTE MARKER
FEDERAL AID URBAN SYSTEM
CORPORATE AND COUNTY LINE
NON-EXISTENT DEDICATED STREET
CENTRAL BUSINESS DISTRICT
RAILROAD AND STATION
POST OFFICE
COURT HOUSE
ELEMENTARY SCHOOL
HIGH SCHOOL
HOSPITAL
ELEVATION

(75)
(15)

PAU

[Symbol: Square with X]
[Symbol: Square with dot]
[Symbol: Circle with cross]
[Symbol: Triangle with dot]

X
+
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•

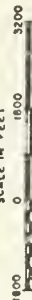
ROAD

T 15816 N
N
R 55856 E

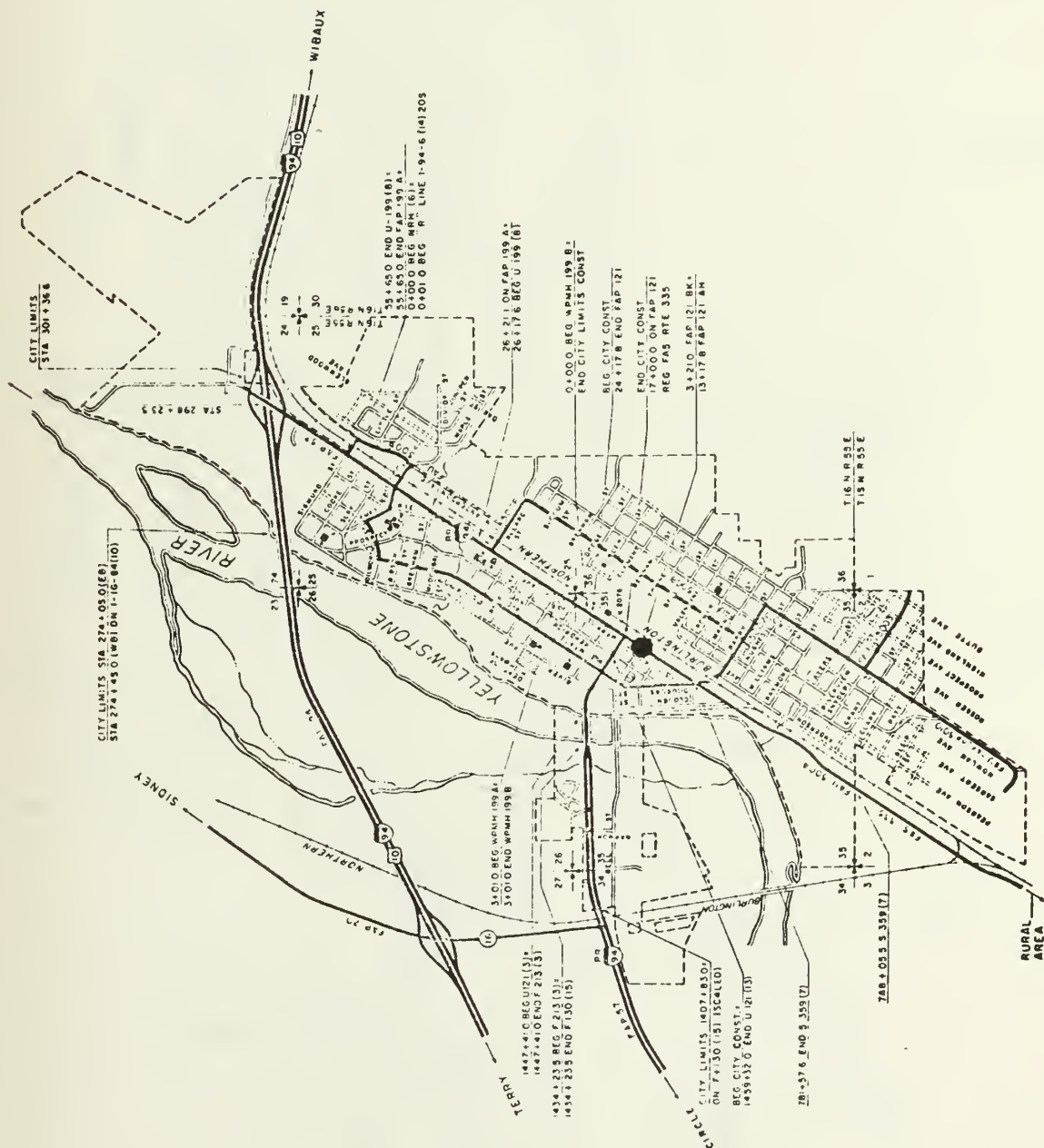


CITY PLAT
GLENDIVE
 DAWSON COUNTY
MONTANA

1970 CENSUS 6,305



REVISED DEC. 31, 1970



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1987 USGS 8498

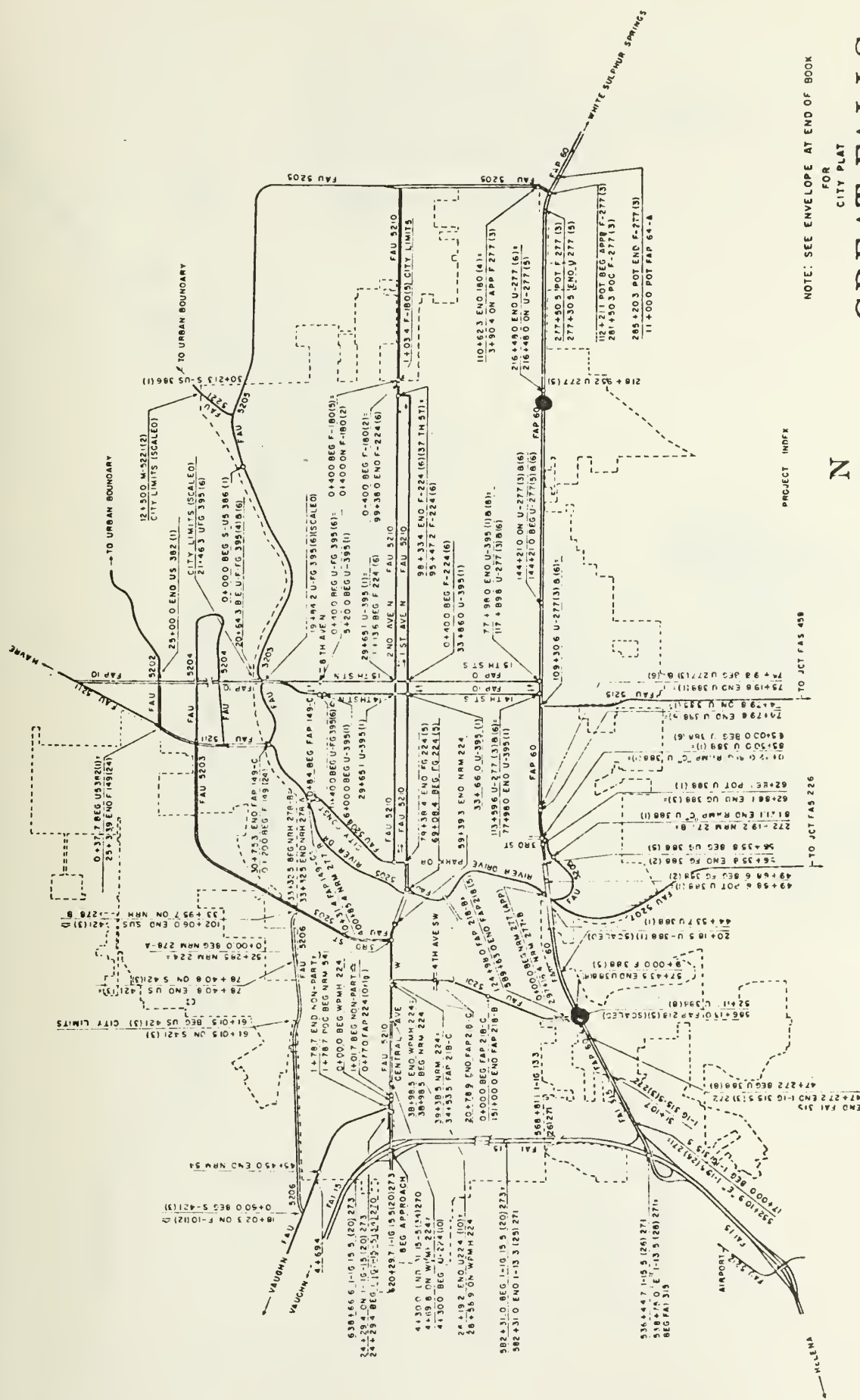
NOTE: SEE ENVELOPE AT END OF BOOK
FOR
CITY PLAT

PROJECT INDEX



GREAT FALLS

CASCADE COUNTY
MONTANA
1970 CENSUS 60,091



CITY PLAY

HELENA

LEWIS & CLARK COUNTY
MONTANA

1970 CENSUS 22.730

PROJECT INDEX

FEDERAL AID HIGHWAY SYSTEMS

PROJECTED ROAD
GRADED AND DRAINED ROAD
GRAVEL OR STONE ROAD
PAVED ROAD

DIVIDED ROAD - TRAFFIC FLOW
FEDERAL AID INTERSTATE SYSTEM
FEDERAL AID PRIMARY SYSTEM
FEDERAL AID SECONDARY SYSTEM
FEDERAL AID URBAN SYSTEM

US NUMBERED ROUTE MARKER
OTHER ROUTE MARKER

CORPORATE BOUNDARY LINE
NON-EXISTENT DEDICATED STREET
CENTRAL BUSINESS DISTRICT
RAILROAD AND STATION

PDST OFFICE
COURT HOUSE
ELEMENTARY SCHOOL
HIGH SCHOOL
HOSPITAL
MOSQUE

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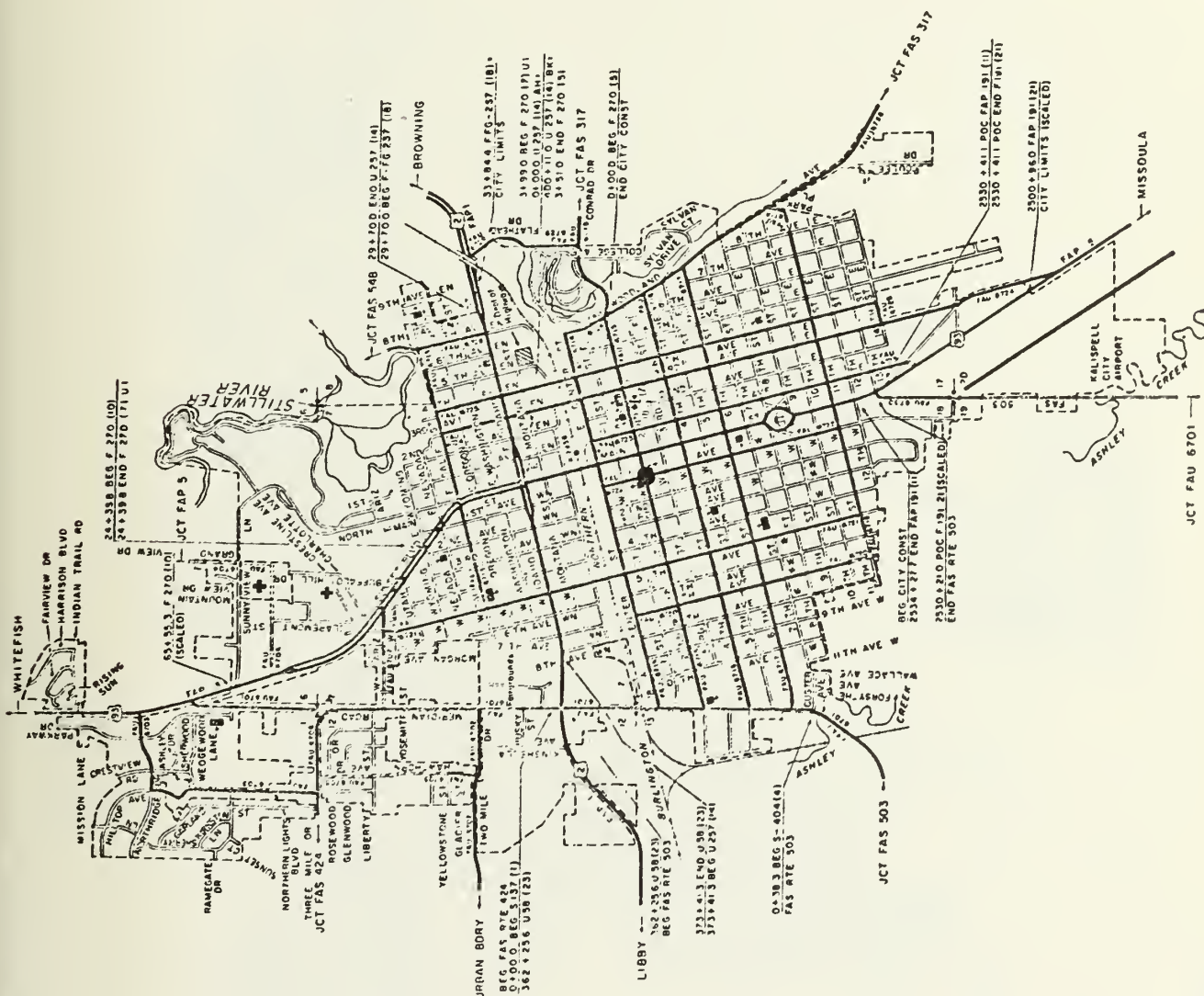
CITY PLAT
KALISPELL
FLATHEAD COUNTY
MONTANA

1970 CENSUS 10,526

A horizontal scale bar labeled "SCALE IN FEET" with markings at 0, 1000, and 2000.

1962 U308 PAGE

REVISED DEC 31 1974



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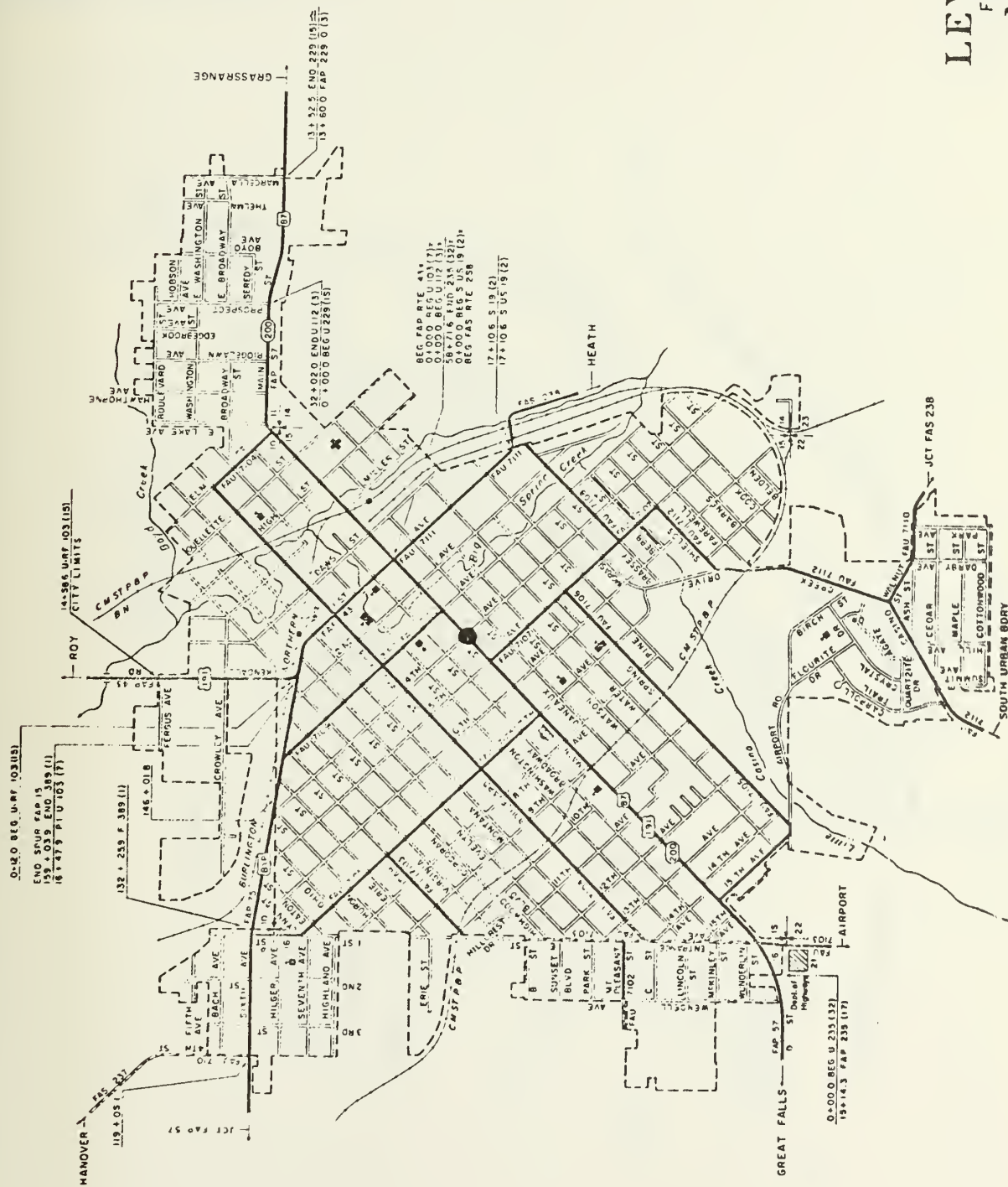
FEDERAL AID HIGHWAY SYSTEMS	PROJECTED ROAD	DIVIDED ROAD - TRAFFIC FLOW	FEDERAL AID INTERSTATE SYSTEM	OTHER ROUTE MARKER	CORPORATE BOUNDARY LINE	NON-EXISTENT DEDICATED STREET	CENTRAL BUSINESS DISTRICT	RAILROAD AND STATION	POST OFFICE	COURT HOUSE	ELEMENTARY SCHOOL	HIGH SCHOOL	HOSPITAL	ELEVATION

CITY PLAT
LEWISTOWN
FERGUS COUNTY
MONTANA

1970 CENSUS 6,437

A horizontal scale bar labeled "SCALE IN FEET" with markings at 0, 800, and 1600.

REVISED DEC 31, 1976



Copies of this map are available for a nominal cost at the Montana Department of Highways—Helena, Montana 59601.

LEGEND

- FEDERAL AID HIGHWAY SYSTEMS
- PROJECTED ROAD
- CRANK AND DRAINED ROAD
- GRAVEL OR STONE ROAD
- PAVED ROAD
- DIVIDED ROAD - TRAFFIC FLOW
- FEDERAL AID INTERSTATE SYSTEM
- FAP
- FEDERAL AID PRIMARY SYSTEM
- FAS
- FEDERAL AID SECONDARY SYSTEM
- INTERSTATE ROUTE MARKER
- US NUMBERED ROUTE MARKER
- STATE ROUTE MARKER
- FEDERAL AID URBAN SYSTEM
- CORPORATE BOUNDARY LINE
- NON-EXISTENT DEDICATED STREET
- CENTRAL BUSINESS DISTRICT
- RAILROAD AND STATION
- POST OFFICE
- COUNT HOUSE
- ELEMENTARY SCHOOL
- HIGH SCHOOL
- HOSPITAL
- ELEVATION

N A

T 2 S () R 9 B U E

CITY PLAT

LIVINGSTON PARK COUNTY MONTANA

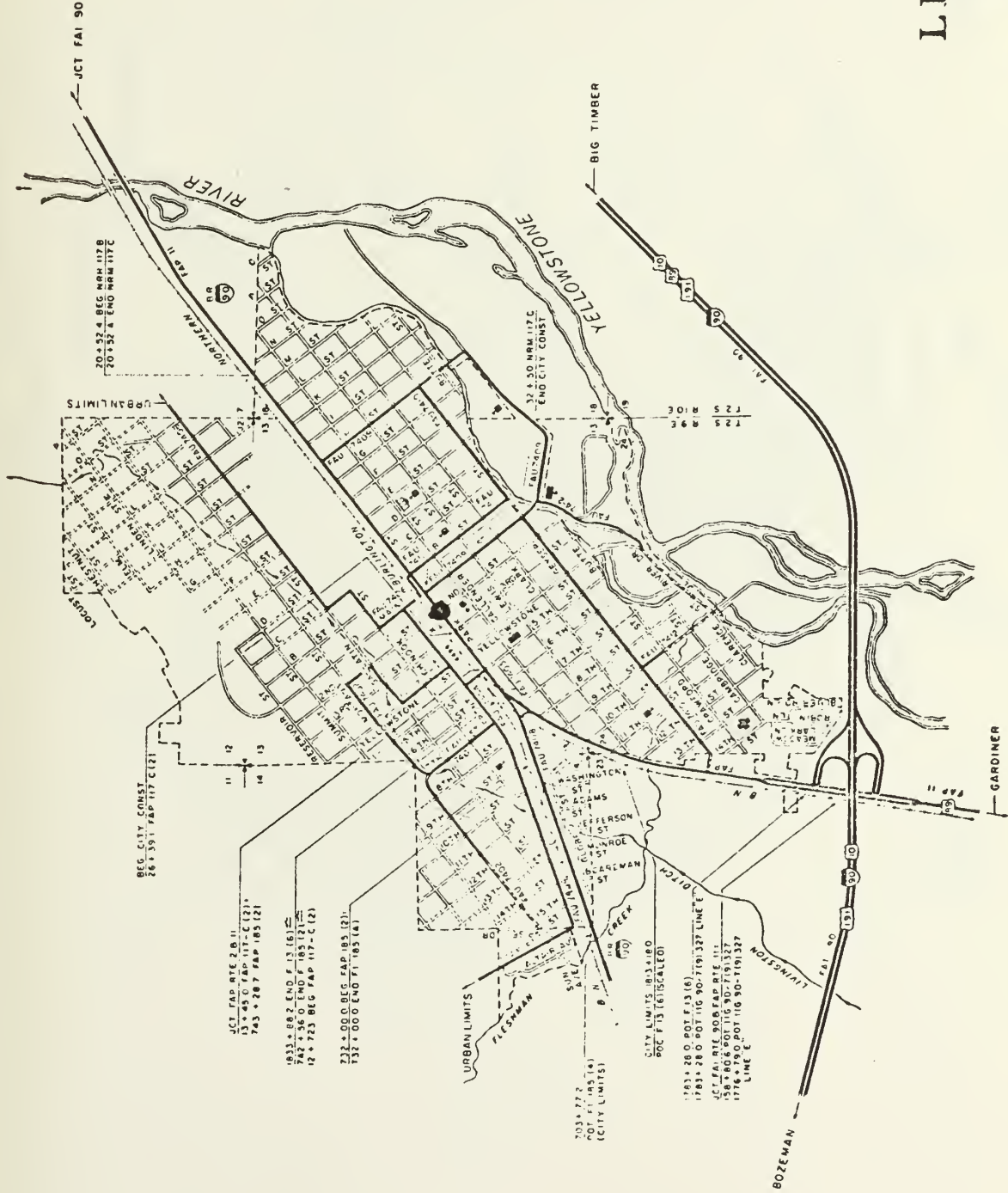
1970 CENSUS 6,883

SCALE IN FEET
1200 0 1200 2400

1931 USGS BASE

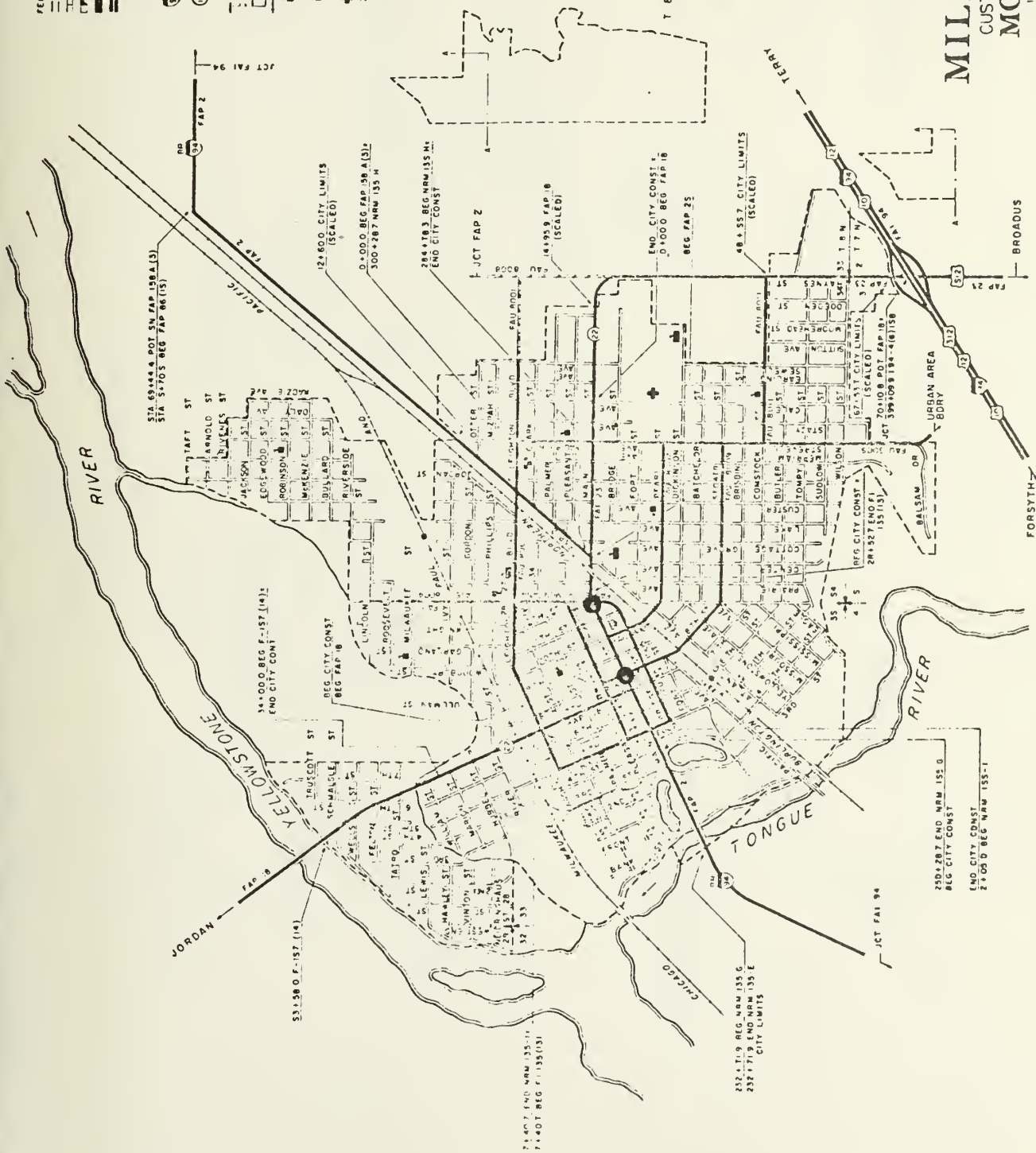
REVISED DEC 31, 1976

Copies of this map are available for a nominal cost of the Montana Department of Highways—Helena, Montana 59601



LEGEND

- FEDERAL AID HIGHWAY SYSTEMS
- PROJECTED ROAD
- GRAVEL AND DRAINED ROAD
- GRAVEL OR STONE ROAD
- PAVED ROAD
- DIVIDED ROAD - TRAFFIC FLOW
- FEDERAL AID INTERSTATE SYSTEM
- FEDERAL AID PRIMARY SYSTEM
- FEDERAL AID SECONDARY SYSTEM
- INTERSTATE ROUTE MARKER
- US NUMBERED ROUTE MARKER
- STATE ROUTE MARKER
- OTHER ROUTE MARKER
- CORPORATE BOUNDARY LINE
- NON-EXISTENT DEDICATED STREET
- CENTRAL BUSINESS DISTRICT
- RAILROAD AND STATION
- POST OFFICE
- COURT HOUSE
- ELEMENTARY SCHOOL
- HIGH SCHOOL
- HOSPITAL
- ELEVATION
- FAU
- FEDERAL AID URBAN SYSTEM



MILES CITY CUSTER COUNTY MONTANA

1970 CENSUS 9023

SCALE IN FEET

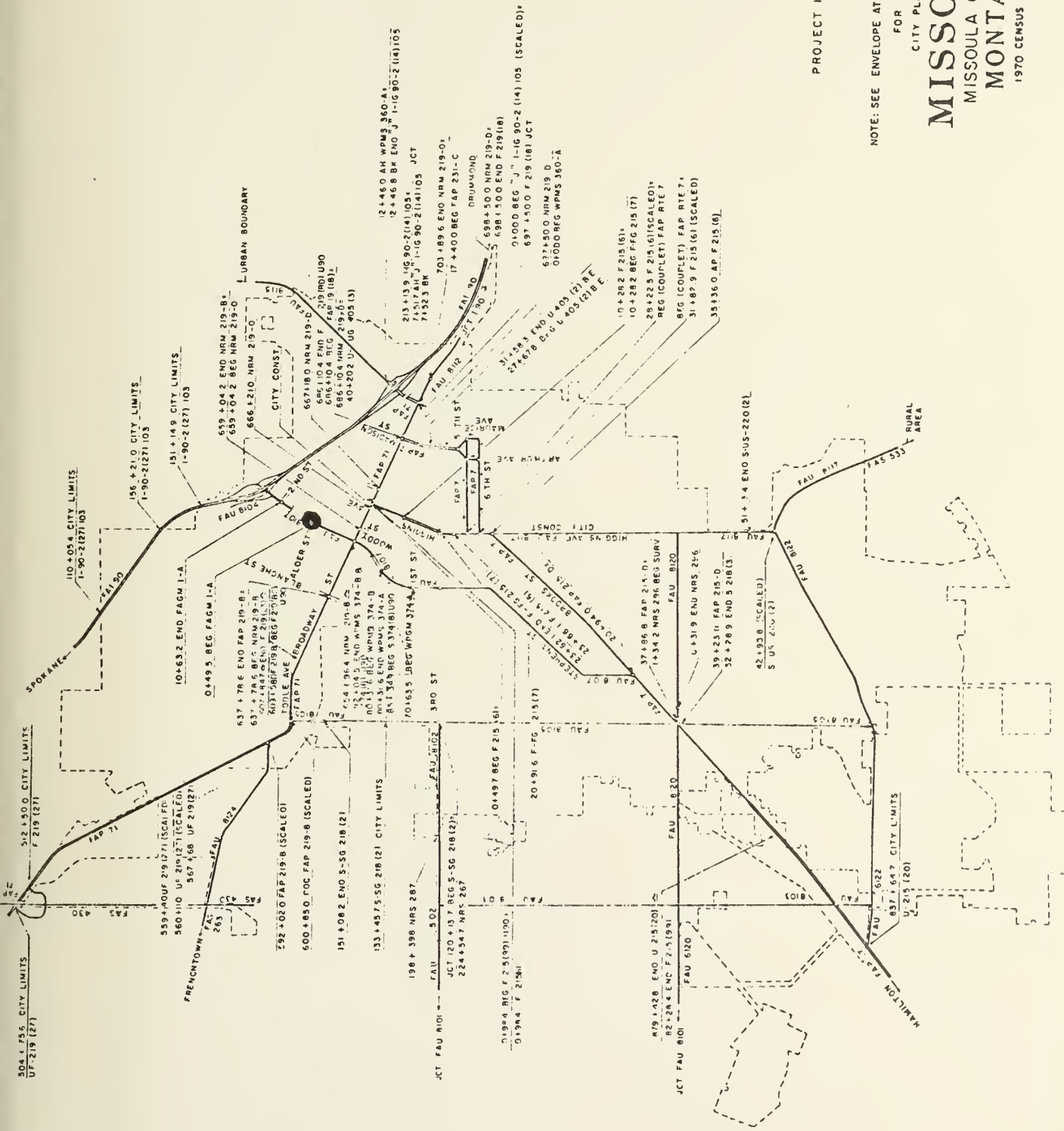
1200 0 1200 2400

REVISED DEC 31, 1976

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NOTE: SEE ENVELOPE AT END OF BOOK
FOR
MISSOULA
MISSOULA COUNTY
MONTANA
1970 CENSUS 29,497

PROJECT INDEX



APPENDIX B

MONTANA ENERGY CONSERVATION--TRAFFIC OBSERVATION

COVER SHEET

CITY _____ DATE _____ TIME _____

LOCATION: Street X _____ Street Y _____

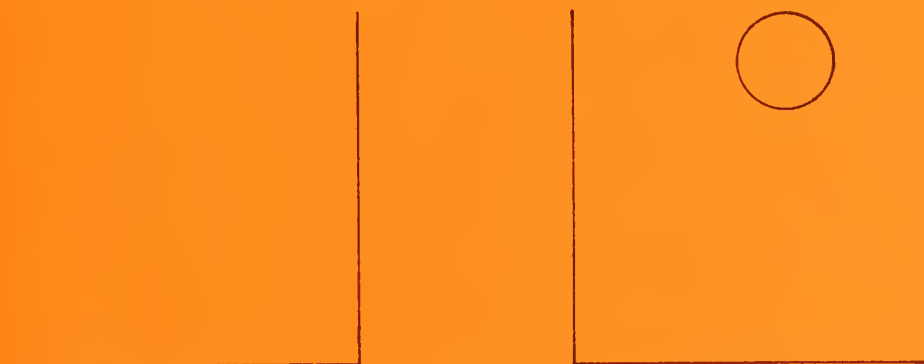
SIGNAL SEQUENCE: red _____ red _____
 (Time in Seconds) amber _____ amber _____
 green _____ green _____

WEATHER CONDITIONS _____ OBSERVER _____

INTERSECTION DIAGRAM:

On the following diagram please:

- (1) Sketch lane markings to show number of lanes, left turn lanes, right turn lanes, etc.
- (2) Note location of signs concerning RTOR, if any, and indicate the wording used on the signs.
- (3) Indicate with arrows the direction of traffic being observed.
- (4) Indicate NORTH with an arrow in the circle.



STREET X

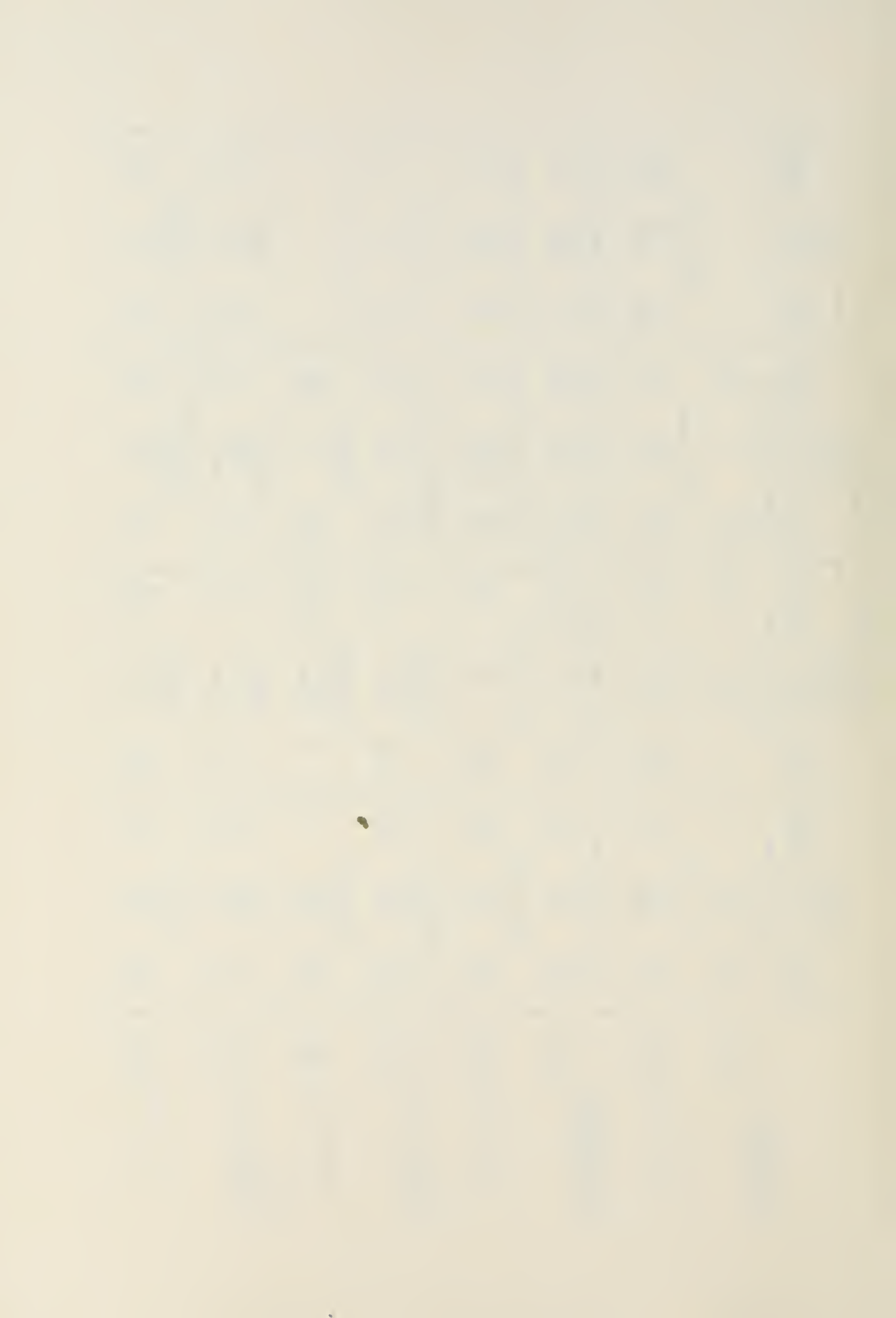


STREET Y

ITY _____ INTERSECTION OF: Street X _____
ED SIGNAL LENGTH: Street X _____ sec. Street Y _____
Street Y _____ sec. OBSERVER _____

[illegible]

APPENDIX C



DIRECTION OF TRAFFIC

		NORTH			SOUTH			EAST			WEST		
		Left	Str.	Right	Left	Str.	Right	Left	Str.	Right	Left	Str.	Right
<u>MISSOULA</u>													
7:00-9:00 a.m.		40	Orange	18	14	Orange	92	45	Spruce	67	75	Spruce	40
ADT		420	4370	160	400	4700	380	960	1150	660	950	1540	830
<u>BOZEMAN</u>													
7:00-9:00 a.m.		0	8th	10	90	8th	173	275	Main	0	2	Main	194
ADT		0	20	70	1300	10	1900	2000	7700	10	10	7300	80
<u>HAVRE</u>													
10:00-12:00 a.m.		33	Wilson	25	143	Wilson	74	3	Main	60	5	Main	180
ADT		150	1140	130	1100	1340	340	10	8000	360	10	7240	1160
<u>KALISPELL</u>													
7:00-9:00 a.m.		31	5th Avenue	7	227	5th Avenue	131	204	U.S. 2	12	12	U.S. 2	124
ADT		210	570	30	1580	300	1360	1220	3030	50	100	3180	2550
<u>ANACONDA</u>													
9:00-11:00 a.m.		33	5th Avenue	69	135	5th Avenue	26	11	3rd Street	16	41	3rd Street	131
ADT		210	3800	290	820	3780	140	60	30	70	260	100	620
<u>KALISPELL</u>													
7:00-9:00 a.m.		4	1st Avenue West	18	36	1st Avenue West	7	46	2nd Street	25	29	2nd Street	54
ADT		184	1863	276	280	1840	506	931	851	908	218	885	580
<u>ANACONDA</u>													
7:00-9:00 a.m.		36	Main	0	0	Main	81		-----		38	Park	94
ADT		680	1480			830	1050	370			370	4190	730
<u>ANACONDA</u>													
10:00-12:00 a.m.		16	Main	10	20	Main	15	11	4th Street	32	21	4th Street	24
ADT		180	1060	260	230	1260	210	140	720	440	240	500	260

DIRECTION OF TRAFFIC

	NORTH			SOUTH			EAST			WEST		
	Left	Str.	Right	Left	Str.	Right	Left	Str.	Right	Left	Str.	Right
MILES CITY 7:00-9:00 a.m. ADT	16 110	8th 23 190	19 120	20 110	8th 38 340	29 210	38 280	Main 310 2750	30 200	12 90	Main 249 1900	15 120
10:00-12:00 a.m. ADT	72 913	Montana 29 440	46 561	5 10	Montana 62 462	78 517	22 50	Main 388 3520	38 160	63 400	Main 585 3600	2 33
GLENDIVE 7:00-9:00 a.m. ADT	5 12	Merrill 197 2932	85 1092	39 506	Merrill 272 2208	0 10	1 20	Parking Lot 0 0	1 10	42 1092	Bell 1 10	33 805
LEWISTOWN 7:00-9:00 a.m. ADT	18 299	5th Avenue 45 264	28 345	15 207	5th Avenue 38 276	25 218	19 69	Main 273 3390	30 310	28 322	Main 234 3036	18 58
LIVINGSTON 7:00-9:00 a.m. ADT	84 990	Park 355 3600	- -	- -	Park 437 4400	135 1400	39 400	2nd Street - -	62 650	- -	- -	- -

APPENDIX D

MONTANA ENERGY CONSERVATION -- PUBLIC OPINION POLL

Please answer the following questions by checking the appropriate spaces.

City _____		<u>YES</u>	<u>NO</u>	
1. Do you live in the city limits?		_____	_____	1
2. Do you have a current Montana driver's license?		_____	_____	2
3. Do you drive to and from work?		_____	_____	3
4. Do you participate in a car pool in going to and from work?		_____	_____	4
5. What is your age range?	<i>under 20</i> _____ <i>21-40</i> _____ <i>41-60</i> _____ <i>over 60</i> _____			5
6. Do you usually ride a bicycle to work? for recreation?		_____	_____	6
7. Would you support the development of bikeways in your community?		_____	_____	7
8. Would you support the use of streets with areas specially designated for bicycles?		_____	_____	8
9. If there were more bikeways, would you ride a bicycle to work more?		_____	_____	9
10. Do you see yourself riding a bike more in the next 5 years?		_____	_____	10
11. Do you think the state's current investment in bikeways is:	<i>too much</i> _____ <i>about right</i> _____ <i>too little</i> _____			11
12. Would you support using state road construction and maintenance funds to build and maintain bikeways?		_____	_____	12
13. Are bike safety information and training adequate in this city?		_____	_____	13
14. Would you support law enforcement of regulations on bike use?		_____	_____	14
15. What is the state law for turning right on a red light?	<i>prohibited</i> _____ <i>generally permitted</i> _____ <i>permitted by sign only</i> _____			15
16. When it is possible to turn right on a red light, how often do you do it?	<i>hardly ever</i> _____ <i>sometimes</i> _____ <i>most of the time</i> _____			16
17. Do you feel that making a right turn on a red light saves gasoline?		_____	_____	17
18. Do you feel that permitting right turns on red is dangerous to you:	<i>as a driver</i> _____ <i>as a pedestrian</i> _____	_____	_____	18
19. Are you ever pressured into making a right turn on red by impatient drivers behind you?	<i>frequently</i> _____ <i>occasionally</i> _____ <i>never</i> _____			19
20. How do you feel about the state law for right turn on a red light?	<i>support it</i> _____ <i>neutral</i> _____ <i>opposed</i> _____			20

THANK YOU FOR YOUR TIME AND COOPERATION

APPENDIX E

NUMBER OF RESPONDENTS -- PUBLIC OPINION POLL QUESTION 15

What is the state law for turning right on a red light?

- 1 - prohibited
- 2 - generally permitted
- 3 - permitted by sign only

POPULATION OF CITIES	AGE OF RESPONDENT																			
	UNDER 20				21-40				41-60				OVER 60			TOTALS				
	1	2	3	Total	1	2	3	Total	1	2	3	Total	1	2	3	Total				
Over 60,000	0	119	2	121	0	171	8	179	0	147	12	159	0	95	12	107	0	532	34	566
20,000-60,000	0	101	13	114	0	291	5	296	0	245	6	251	0	123	5	128	0	760	29	789
10,000-20,000	0	132	13	145	0	247	16	263	0	262	12	274	0	114	13	127	0	755	54	809
8,000-10,000	0	85	31	116	0	133	7	140	0	183	8	191	0	101	8	109	0	502	54	556
6,000-8,000	0	68	7	75	0	153	24	177	0	264	15	279	0	214	15	229	0	699	61	760
TOTALS	0	505	66	571	0	995	60	1055	0	1101	53	1154	0	647	53	700	0	3248	232	3480

NUMBER OF RESPONDENTS -- PUBLIC OPINION POLL QUESTION 17

Do you feel that making a right turn on a red light saves gasoline?

POPULATION OF CITIES	AGE OF RESPONDENT											
	UNDER 20			21-40			41-60			OVER 60		
	Yes	No	Total	Yes	No	Total	Yes	No	Total	Yes	No	Total
Over 60,000	121	0	121	179	0	179	159	0	159	107	0	107
20,000 - 60,000	111	2	113*	296	0	296	251	0	251	128	0	128
10,000 - 20,000	145	0	145	263	0	263	274	0	274	123	4	127
8,000 - 10,000	116	0	116	139	1	140	190	1	191	108	1	109
6,000 - 8,000	75	0	75	177	0	177	277	2	279	229	0	229
TOTALS	568	2	570*	1054	1	1055	1151	3	1154	695	5	700
										3468	11	3479*

* 1 person did not respond to this question.

NUMBER OF RESPONDENTS -- PUBLIC OPINION POLL QUESTION 18b

Do you feel that permitting right turns on red is dangerous to you as a pedestrian?

POPULATION OF CITIES	AGE OF RESPONDENT											
	UNDER 20			21-40			41-60			OVER 60		
	Yes	No	Total	Yes	No	Total	Yes	No	Total	Yes	No	Total
Over 60,000	2	119	121	13	166	179	27	132	159	22	85	107
20,000 - 60,000	5	109	114	11	285	296	24	227	251	6	122	128
10,000 - 20,000	6	139	145	43	220	263	32	242	274	29	98	127
8,000 - 10,000	16	100	116	3	137	140	12	179	191	24	85	109
6,000 - 8,000	14	61	75	9	168	177	49	230	279	35	194	229
TOTALS	43	528	571	79	976	1055	144	1010	1154	116	584	700
										382	3098	3480

NUMBER OF RESPONDENTS -- PUBLIC OPINION POLL QUESTION 20

How do you feel about the state law for right turn on a red light?

1 - support it
2 - neutral
3 - opposed

POPULATION OF CITIES	AGE OF RESPONDENT																			
	UNDER 20				21-40			41-60			OVER 60			TOTALS						
	1	2	3	Total	1	2	3	Total	1	2	3	Total	1	2	3	Total				
Over 60,000	121	0	0	121	179	0	0	179	159	0	0	159	107	0	0	107	566	0	0	566
20,000-60,000	113	1	0	114	296	0	0	296	251	0	0	251	124	1	3	128	784	2	3	789
10,000-20,000	145	0	0	145	263	0	0	263	273	1	0	274	123	4	0	127	804	5	0	809
8,000-10,000	116	0	0	116	138	2	0	140	191	0	0	191	107	2	0	109	552	4	0	556
6,000-8,000	75	0	0	75	177	0	0	177	279	0	0	279	229	0	0	229	760	0	0	760
TOTALS	570	1	0	571	1053	2	0	1055	1153	1	0	1154	690	7	3	700	3466	11	3	3480

